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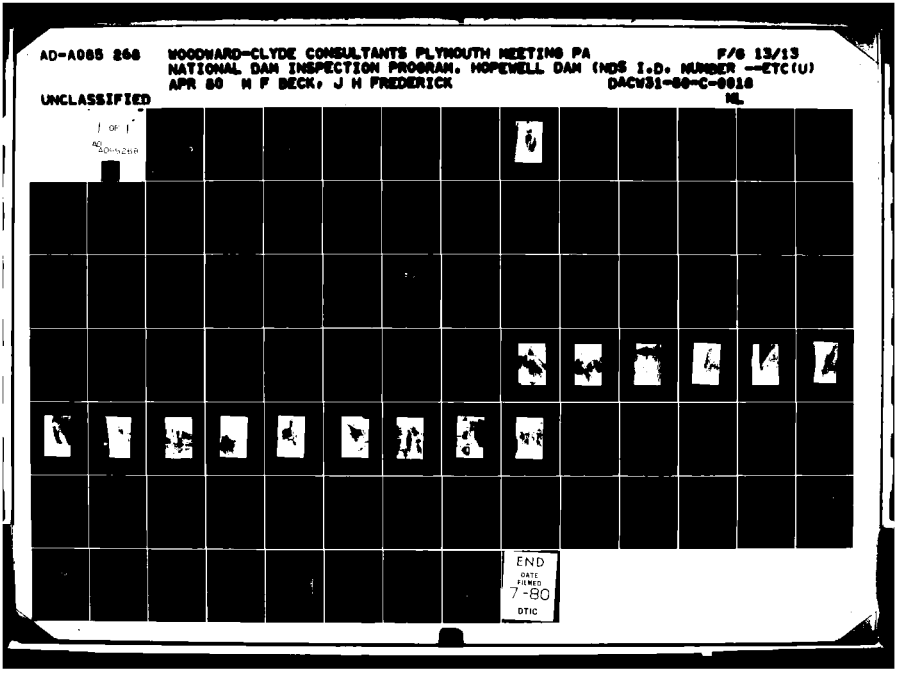

DELAWARE RIVER BASIN

SCOTTS RUN, BERKS COUNTY

PENNSYLVANIA
NDS ID PA. 00724
DER ID 6-401

LEVEL II

HOPEWELL DAM

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

WOODWARD-CLYDE CONSULTANTS

DACW31-80-C-0018

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

APRIL 1980

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DELAWARE RIVER BASIN

SCOTTS RUN

HOPEWELL DAM, BERKS COUNTY, PENNSYLVANIA

NDS I.D. ~~NO.~~ PA 00724
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PHASE I INSPECTION REPORT
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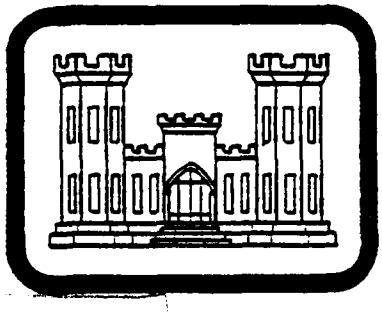

Prepared by:

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Submitted to:

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

APR ~~1980~~

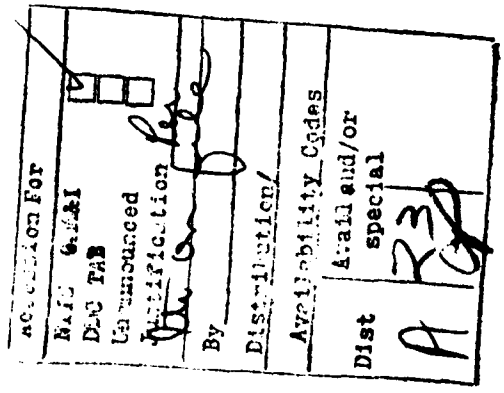
PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams for Phase I Investigations. Copies of these guidelines may be obtained from the Office of the Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to expeditiously identify those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigations, testing and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify the need for more detailed studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected, and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.



PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

Name of Dam:	Hopewell Dam
County Located:	Berks County
State Located:	Pennsylvania
Stream:	French Creek
Coordinates:	Latitude 40° 12.3'
	Longitude 75° 46.7'
Date of Inspection:	March 20, 1980

Hopewell Dam is a recreational structure located in French Creek State Park and owned by the Commonwealth of Pennsylvania. Visual inspection and review of the design and construction documentation indicate that the dam and appurtenant structures of Hopewell Dam are in good condition, although the condition of the dormant vegetation appeared to be fair at the time of the inspection.

In accordance with criteria established by Federal (OCE) Guidelines, the spillway design flood for this "Small" size dam and "High" hazard classification is one-half to the full Probable Maximum Flood (PMF). As the dam's total capacity is near the upper limit of the size classification and Hopewell Village is located at a narrow section of the floodplain, the selected spillway design flood is the full PMF. Hydrologic and hydraulic computations presented in Appendix D indicate the spillway is capable of passing approximately 33 percent of the PMF without overtopping the embankment. As the one-half PMF is estimated to cause failure of the structure and to significantly increase the potential for downstream damage, the spillway system of this structure is considered to be "Seriously Inadequate" and the dam is in an "unsafe, nonemergency" condition.

It is recommended that the following measures be undertaken as soon as practical. Items (1) through (3) should be under the direction of a registered professional engineer experienced in the design and construction of dams.

(1) A study should be made to determine the best method of increasing the spillway capacity to meet current hydrologic/hydraulic criteria.

(2) The large trees on the embankment to the left of the spillway should be removed, and the long-term stability of the slope should be evaluated in the light of the decaying root systems.

(3) The embankment should be raised to the design elevation on the left side of the spillway, and the entire embankment crest should be leveled.

(4) As planned during the routine spring maintenance of the embankment, the woody vegetation should be removed. It is recommended that the written operation and maintenance manual be expanded to include procedures for maintenance of embankment vegetation.

(5) The mortar joints in the spillway should be repaired.

Because of the location of the dam upstream of the Hopewell Village National Historic Site and the potential to cause extreme property damage and possible loss of life in the event of failure, a formal procedure of observation and warning during periods of high precipitation should be developed and implemented. This procedure should include a method of warning downstream personnel if high flows are expected and provisions for evacuating these people in the event of an emergency. It is recommended that the operation and maintenance manual be expanded to include procedures for the maintenance of the embankment vegetation. It is also recommended that errors in the manual with respect to the physical features of the dam be corrected.

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APPROVED BY:

James W. Peck — 21 MAY 80

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

Date

OVERVIEW
HOPEWELL DAM, UNION TOWNSHIP, BERKS COUNTY, PENNSYLVANIA

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
HOPEWELL DAM
NATIONAL ID NO. PA 00724
DER NO. 6-401

SECTION 1
PROJECT INFORMATION

1.1 General.

a. Authority. The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Hopewell Dam is a zoned earth fill dam about 29 feet high and 1,000 feet long. The upstream section, reportedly constructed of relatively impervious materials, has a design slope of not less than 3H:1V. At the waterline, the embankment is protected with hand placed riprap, as shown in Photograph 5. The central portion of the dam and underlying cutoff trench were constructed of select core materials reported to be clay. The top of the dam and central core section are 12 feet wide. The cutoff trench is 10 feet wide at the bottom, with 1H:2V side slopes, and was designed to be carried to an impervious rock base. The downstream zone is reportedly constructed of pervious materials, and the design slope was not less than 2H:1V. Stone steps approximately 80 feet right of the spillway protect the embankment from foot traffic. The design elevation at the top of the dam is 510.67 feet.

The spillway is located near the left abutment of the dam. The ogee weir and spillway retaining walls are concrete faced with stone. The weir is 42 feet long with a crest elevation of 505 and has an eight foot long notch in the center, which measures six inches deep instead of three inches, as shown on Plate 3, Appendix E. The upper portion (about four feet) of the weir is faced with small stones, permitting a relatively smooth ogee shape. The facing stones for the rest of the weir and the retaining walls are up to two

feet thick, making a series of steps, as shown in Photograph 3. A 30 inch drain pipe, gated at its upstream end immediately upstream of the weir, discharges through the spillway and has intake and discharge elevations of about 483. The control tower is provided with channels for the use of stop-logs. Not shown on any plans is a rectangular concrete intake tunnel from the spillway backfill upstream toe to the control tower. The spillway discharges into a large rock stilling basin; see Photograph 4. A single line grout curtain was installed in the rock under the spillway, as described in paragraph g below, and concrete cutoff walls extend ten feet into the embankment on both sides of the spillway.

b. Location. Hopewell Dam is located across French Creek in Union Township, Berks County, Pennsylvania. The dam site is located approximately three miles north of the intersection of Pennsylvania Routes 23 and 345. The dam site and reservoir are located on the USGS Quadrangle map entitled, "Elverson, Pennsylvania", at coordinates N 40° 12.3' W 75° 46.7'. A regional location plan of Hopewell Dam and reservoir is enclosed as Plate 1, Appendix E.

c. Size Classification. The dam is classified as a "Small" size structure by virtue of its 29 foot height and estimated total capacity of 943 acre-feet.

d. Hazard Classification. Hopewell Dam is located immediately upstream of the boundary of the Hopewell Village National Historic Site. There are several buildings of historic value within the park, about 1,200 feet downstream of the dam, and the park superintendent's house is only two feet above the stream bank channel. Therefore, Hopewell Dam is considered to have a "High" hazard classification.

e. Ownership. Hopewell Dam, located within French Creek State Park, is owned by the Commonwealth of Pennsylvania. All correspondence should be addressed to Resources Management, Bureau of Operations, Department of Environmental Resources, Post Office Box 1467, Harrisburg, Pennsylvania 17120.

f. Purpose of Dam. The dam was originally built for recreational purposes and also serves as a water supply for the waterwheel at the reconstructed iron mill at the downstream Hopewell Village.

g. Design and Construction History. Hopewell Dam was designed by the Department of the Interior National Park Service as a Civilian Conservation Corps (CCC) project. The dam was built to replace a smaller stone dam that had created a lake at elevation 488.8. By September 1935, a dam with a

broad crested spillway 50 feet wide at elevation 498 had been designed for the site. By December 1935, the spillway was redesigned to be an ogee section 42 feet wide at elevation 505.

Construction of Hopewell Dam began early in 1936. In March 1936, excavation in the spillway area was carried to elevation 483.5, at which depth the rock was considered unsatisfactory for the spillway foundation and was not sufficiently impervious to be used as the bottom of the cutoff trench under the earth embankment. A test pit was then excavated in the left hillside at a point where the original ground surface was about 503. The top of rock at the test pit was 495, the bottom of the test pit was 483, and a hole was drilled to elevation 478. From the top of the rock to nearly the bottom of the pit, the rock was described as sandstone blocks separated by wide seams in all directions. The bottom of the pit consisted of badly broken shale. The drill hole in the bottom of the pit indicated a harder and more compact rock beneath the bottom of the pit. It was decided to shift the spillway structure 20 feet to the south in an effort to reduce rock excavation and to obtain a better foundation.

A state engineer recommended that the cutoff wall on the left of the spillway be continued into the left abutment hillside in the form of a low wall, with the top at least two feet above the rock surface. He also noted the desirability of constructing a low cutoff wall to the right end of the dam, embedded two feet into the foundation, if warranted by the condition of the foundation after excavation. The concrete wall was to act as an added seal between the bottom of the dam and the clay core. (There is no evidence that the cutoff wall on the right side was constructed.) The state engineer also noted that grouting might be necessary to prevent leakage under the dam. In May 1936, after inspecting the revised spillway foundation excavation, the state engineer formally recommended that a single line grout curtain be installed under the spillway, with holes on three feet centers and to a depth of about 15 feet. In July, grouting pipes were installed at three foot intervals. Every third or fourth hole was to be grouted initially, and then the intermediate holes would be grouted if necessary. It was also noted that the cutoff wall on the left side of the spillway would extend about 25 feet into the hillside. In October 1936, a state progress report noted that the job as a whole was 50 percent complete and the work quality satisfactory.

In January 1937, work on the dam was halted until warmer weather in March. A June 1937 inspection of the dam site indicated that fill was being placed containing too much moisture, and that compaction was not quite sufficient. Fill

was being placed faster than it could be properly compacted. The Department of the Interior replied that more care would be taken in placing the material and reported that recent compaction tests indicated good results. They also reported that it was decided not to install the cutoff wall to the left of the spillway, but that weep holes would be installed through the downstream spillway wing walls. "Graded gravel wells", designed to permit the passage of water and at the same time retain the embankment material, would be installed to control any seepage between the spillway and the left abutment. A state progress report later in the same month indicated that embankment fill was being placed satisfactorily.

On August 3, 1937, the Department of the Interior National Park Service notified the state that on Friday, August 6, the gates of the dam at Hopewell, Pennsylvania, would be closed. On October 18, 1937, a state inspection report noted that work was in progress for the stilling pool. Leakage amounting to about 300 gallons per day was coming through the left wing wall downstream. According to reports, this leakage was from springs. On June 5, 1938, water flowed over the crest of the spillway for the first time.

Hopewell Dam was deeded to the Commonwealth of Pennsylvania on November 25, 1946. The terms of the deed allowed the Department of the Interior, through the National Park Service, to take water from Hopewell Lake to operate the water wheel at the Hopewell Furnace, downstream of the dam. In 1951, a water supply line was laid through the dam. An eight inch pipe with an intake about 100 feet out in the reservoir was installed. Flow through the pipe is controlled by a gate valve located in a locked valve box to the left of the spillway.

On March 19, 1962, the lake was lowered to work on the swimming beaches and boat docks. In April, and again in May, unsuccessful attempts were made to close the gate. An August 1962 state inspection noted that the gate was still not closed. The lake was subsequently drawn down again to repair the sluice gate. A December 1962 State Parks Department inspection report noted that the lake had been drawn completely, the valve cleaned, the bottom of the inlet tunnel and tower were cleaned of debris, iron parts were scaled and painted with rustoleum, and the valve closed on October 25.

In 1966, it was thought that the valve was in danger of failing, and a contract was awarded to repair or replace the valve. The contractor found that the valve, which was constructed of brass, was in good working order, but that the openings in the trash rack were too large, allowing stones and

other debris to lodge in the gate. Extra bars were added to the trash rack to prevent this occurrence.

About 1975, fill was placed at the downstream toe to the right of the spillway, filling in a marshy area and creating an access road to the stilling basin.

h. Normal Operating Procedures. Excess water is normally discharged over the spillway, and water is drawn off for use at the furnace at Hopewell Village.

1.3 Pertinent Data.

The summary of pertinent data for Hopewell Dam is presented as follows.

a.	Drainage Area (square miles)	2.56
b.	Discharge at Dam Site (cfs)	
	Maximum Known Flood at Dam Site	Unknown
	At Top of Dam	1,747
c.	Elevation (feet above MSL)	
	Top of Dam	
	Existing	509.9
	Design	510.67
	Spillway Weir Crest	505.0
	Water Supply Intake	502±
	Pond Drain Inlet	483.0
	Stream Bed at Downstream Toe (est)	481.0
d.	Reservoir Length (feet)	
	Length at Normal Pool	3,500
	Length at Maximum Pool (est)	4,000
e.	Storage (acre-feet)	
	To Spillway Crest (normal pool)	569
	To Top of Dam (existing)	943
f.	Reservoir Surface Area (acres)	
	Normal Pool	66
g.	Embankment Data	
	Type	Zoned earth w/ clay core & cutoff trench
	Length	1,000 feet
	Maximum Height (above stream bed at downstream toe)	29 feet

	Top Width	12 feet
	Volume	24,000 cubic yards
	Side Slopes	
	Upstream	3H:1V
	Downstream	2H:1V
	Cutoff	Clay filled cutoff trench to rock, 10 ft wide at base, w/ 1H:2V side slopes
	Grout Curtain	Single line grout curtain under spillway
h.	Spillway	
	Type	Ogee weir, concrete with stone facing
	Length	42 feet
	Weir Crest Elevation	505.0, with 8 foot long notch
	Notch Elevation	
	Design	504.75
	Existing	504.5
i.	Pond Drain	
	Type	30 inch pipe through spillway, 22 feet long, w/ sluice gate at upstream end
	Inlet Elevation	483.0

SECTION 2
ENGINEERING DATA

2.1 Design.

a. Data Available. The data available for review are contained in the Pennsylvania Department of Environmental Resources (DER) files and consist of plans, photographs, correspondence, inspection reports and memoranda. Engineering analyses located in DER files are limited to a stability analysis of the spillway section and evaluations of the spillway capacity.

b. Design Features. The principal design features of Hopewell Dam are illustrated on the plans and cross-sections enclosed in Appendix E. Data for these sections were obtained from plans located in DER files. The design features are also described in Section 1.2, paragraph a, and pertinent data relative to the structure are presented in Section 1.3.

2.2 Construction.

The known construction information is detailed in Section 1.2, paragraph g.

2.3 Operational Data.

There are no operational records maintained.

2.4 Evaluation.

a. Availability. Information presented herein was obtained from the records located in DER files in Harrisburg, Pennsylvania, and from conversations with the Owner's representative.

b. Adequacy. The available data included in the state files are not considered adequate to evaluate the engineering aspects of the dam and appurtenant structures.

c. Validity. There is no reason to question the validity of the available data. It is noted that plans for two dams with different elevations and spillways are included in DER files. Appendix E contains only those plans pertaining to the existing dam.

SECTION 3
VISUAL INSPECTION

3.1 Findings.

a. General. Observations and comments of the field inspection team are contained in the checklist enclosed herein as Appendix A, and are summarized and evaluated in the following subsections. In general, the appearance of the facility indicates that the dam is in good condition. Plan and cross-sections of the dam are presented in Appendix E.

b. Dam. During the visual inspection, there were no indications of distortions in alignment or grade that would be indicative of movement of the dam or the foundation. The vertical alignment of the dam was checked, and a profile is included in Appendix A as sheet 5B. Hand-placed riprap protects the upstream face of the embankment along the waterline. One or two stones are out of position near the spillway. Above the riprap, the embankment is protected with grass. There is a small amount of erosion on the upstream embankment near the right end of the dam. The crest is uneven, both longitudinally, as shown in the profile on sheet 5B, and perpendicular to the profile. Near the left end of the embankment on the upstream side is a swale that appears to have been made by foot traffic and which has been reseeded.

The crest of the dam is protected with mine screenings, consisting of coarse sand and fine gravel size rock fragments. Both the upstream and downstream embankments are steepest near the top. This possibly results from additional topsoil being placed on the dam during previous repairs. The lower portion of the downstream embankment is hummocky, or uneven. A set of stone steps, as shown on Photograph 8, and which are not shown on the plans, were installed on the downstream face of the dam when it was constructed. There are two small cedar trees growing near the steps, as shown in Photographs 7 and 8. About five years ago, an access road was made to the spillway stilling basin along the downstream toe of the bank, filling in a marshy area. At one point, about midway between the right abutment and the spillway, this road does not appear to drain well, and there is a soft spongy area extending up onto the embankment a short distance. At the junction of the downstream embankment and right abutment, a stone paved gutter carries surface runoff. About 60 feet downstream of the dam, as shown on sheet 5A, is a marshy area with standing water. Three springs were noted downstream of the dam to the left of the discharge channel. While seepage under the dam cannot be completely ruled out,

this water is assessed to be principally the result of hillside seepage.

The vegetation on the downstream slope consists of grass, particularly near the right abutment, and near the maximum section consists of Crownvetch, grass and briars, with woody vegetation gaining foothold. The grass was in a dormant state at the time of the inspection, but appeared to be in fair condition. The Owner's representative indicated that soil tests and fertilization were not done. Large trees and brush are on the downstream embankment to the left of the spillway. While the area to the left of the spillway resembles natural ground, construction photographs indicate that this is fill material. On both sides of the stilling basin, foot traffic has worn paths through the vegetation.

The original design called for six "seepage detector pipes" to be installed through the embankment, as shown on Plate 2. Park employees knew of only one pipe, shown on Photograph 9. The cap was removed and the water depth was measured to be 20 feet below the top of the dam crest, and the total length of the pipe to be about 30 feet.

c. Appurtenant Structures.

1. Spillway. The concrete ogee weir, faced with stone, appears to be in good condition, with some leakage through it. DER files and visual inspection indicate that the mortar joints of the weir and spillway walls are repaired periodically. Visual inspection indicated two small holes in the mortar of the small stones of the ogee section between the notch and the left spillway wall. Between the spillway notch and the right spillway wall, water was leaking through the weir at the junction of the small facing stones with the large facing stones; see Photograph 11. Between the notch and the left spillway wall, water was seeping through the mortar joints. Water was also leaking through both the left and right spillway walls. The surface of the rock was stained almost from the top of the wall, indicating leakage. Leakage through both spillway walls has been of a long-term occurrence, as leakage has been noted in the state files since the reservoir was filled, and as evidenced by a stalagmite of about an inch in height which has developed on the left spillway wall. No movement of the spillway walls was noted. No erosion of the downstream channel below the stilling basin was noted. Relief drains through the left stilling basin walls referred to in DER files were not located.

2. Outlet Works. The intake conduit and sluice gate are completely underwater. Water is discharged through a 22 foot long, 30 inch conduit through the spillway, and

outlets as shown in Photograph 3. In order to operate the pond drain gate, a platform of concrete blocks and planks is constructed on top of the stop-log structure, as shown in Photograph 2. The gate was seated completely before operation, operated easily and seated completely again afterwards.

d. Reservoir. The reservoir side slopes are moderate and well vegetated to the water's edge with grass and trees. Little debris was noted. There is little sediment at the upper end of Hopewell Lake, which would have little or no effect on flood water storage. About 5/8 mile upstream of Hopewell Dam is Scott's Run Dam, also within French Creek State Park. This dam is about 34 feet high and has a maximum pool storage capacity of 425 acre-feet.

e. Downstream Channel. Immediately below the dam, the 20 foot wide, two foot deep, channel flows through a wooded area to the Hopewell Village National Historic Site. The village itself is located adjacent to the channel about 1,200 feet below the dam. The park superintendent's house is a few feet above the channel bank, and there are several other historical buildings and a house that are two feet above the channel bank and would be damaged in the event of failure. There are no other significant damage centers for over a mile downstream of Hopewell Village. Thus, in the event of failure, excessive property damage is likely and possible loss of life, justifying a "High" hazard potential classification.

3.2 Evaluation.

In summary, the visual survey of the dam and appurtenant facilities disclosed no evidence of incipient failure of the dam. Items noted of a routine maintenance nature include cutting brush and woody vegetation on the downstream slope and repairing two small holes in the mortar of the spillway. More extensive rehabilitation would consist of removal of large trees to the left of the spillway and restoring the embankment to its original condition.

Seepage through the spillway and stilling basin walls is assessed to represent a stable condition and to require only visual monitoring.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures.

Operation of the dam does not require a dam tender. Water normally discharges over the spillway at elevation 505. Operating procedures include maintaining a sufficient downstream flow to maintain fish life if the reservoir level is below the spillway crest. Hopewell Village also draws off water for operation of the water wheel at the downstream furnace.

4.2 Maintenance of the Dam.

The Bureau of State Parks has developed an operation and maintenance manual for Hopewell Dam. Park employees provide maintenance for the dam. It is noted that although procedures are suggested for seeding areas, no procedures were suggested for maintaining a good vegetative cover on the embankment.

4.3 Maintenance of Operating Facilities.

The pond drain gate is operated at least twice a year. Procedures for inspection and maintenance of operating facilities are included in the operation and maintenance manual.

4.4 Warning Systems In Effect.

There are no written warning procedures in effect for this dam. The park has a general warning procedure in which a siren is sounded indicating an emergency. Park employees would then report to headquarters for details and instructions.

4.5 Evaluation.

It is judged that the current operating procedure, which does not require a dam tender, is a realistic means of operating the relatively simple control facilities of Hopewell Dam. The written operation and maintenance manual was reviewed, and the recommendation is made that provisions be made for adequate maintenance of embankment vegetation. A

warning procedure should be developed and implemented that would include surveillance of the dam during periods of high rainfall runoff.

It is also noted that the manual contains factual errors relative to the physical features of the dam. These errors (elevations, dimensions, etc.) are based on an early design of the dam, which was subsequently revised prior to construction.

SECTION 5
HYDROLOGY/HYDRAULICS

5.1 Evaluation of Features.

a. Design Data. The original design data for this dam were located in the Department of Environmental Resources files and were available for review. The original data are dated 1935. Hydrologic and hydraulic calculations made as a part of this investigation are contained in Appendix D.

The watershed is small and undeveloped, located almost entirely within French Creek State Park boundaries. The oval shaped watershed is about 2.2 miles long and 1.4 miles wide, having a total area of 2.56 square miles. Elevations range from about 1,000 feet in the upper reaches to 505, normal pool elevation. The upper 1.0 square mile of the watershed is controlled by Scott's Run Lake Dam, located about 3,300 feet above Hopewell Lake. The Scott's Run Watershed is over half wooded, with the rest open/farmland. There is almost no residential development within the watershed. The Hopewell Lake Watershed is almost completely wooded. Development within the watershed is limited to development of recreational facilities within the park. The runoff characteristics of either watershed are not expected to change significantly with time.

The original design information on Hopewell Dam indicates a spillway capacity of 1,674 cfs, based on a 42 foot long ogee weir, a coefficient of discharge equal to 3.95 and a design head of 4.67 feet. Original calculations indicated that the spillway is capable of safely passing the runoff of 0.96 inche per hour for ten hours, or 8.3 inches of runoff.

In accordance with criteria established by Federal (OCE) Guidelines, the recommended spillway design flood for this "Small" size dam and "High" hazard classification is one-half to the full Probable Maximum Flood (PMF). As the total storage capacity of this dam is close to the upper limit for a "Small" size classification and Hopewell Village is located at a narrow section of the floodplain, the full PMF has been selected as the spillway design storm.

b. Experience Data. No reservoir level records are maintained. The only estimate available of previous high reservoir levels is a maximum depth of 18 inches over the weir during Hurricane Agnes, June 1972. It is noted that Hopewell Lake does not lie in the path of maximum rainfall for that event.

c. Visual Observations. On the date of the inspection, there were no conditions observed that would indicate a reduction in spillway capacity in the event of a large storm. Other observations regarding the condition of the downstream channel, spillway and reservoir are presented in Appendix A and are discussed in greater detail in Section 3.

d. Overtopping Potential. The overtopping potential of this dam was estimated using the HEC-1, Dam Safety Version, computer program. A brief description of this program is included in Appendix D. Calculations for this investigation estimate the maximum spillway capacity to be about 1,750 cfs when the reservoir level is at the minimum crest elevation. The HEC-1 computed PMF peak inflow is 7,885 cfs for the existing watershed, considering the effect of upstream Scott's Run Dam. The spillway passes about 33 percent of the PMF without overtopping the dam.

e. Spillway Adequacy. The spillway is considered "Seriously Inadequate" as all of the following criteria are met.

(1) The spillway will not pass 50 percent of the PMF without overtopping the dam.

(2) It is assessed that overtopping by the 0.5 PMF will cause failure.

(3) There would be a significant increase in property damage and the potential for loss of life as a result of failure by overtopping.

The overtopping potential is discussed in the above paragraph. Based on visual observations, the embankment is assessed to fail if overtopped by about nine inches of water for an hour or more. The increase in hazard due to failure is discussed in the following paragraph.

f. Downstream Conditions. About 1,200 feet below the dam within the Hopewell Village National Historic Site is a road with several buildings along it, as shown on Plate 1. Photograph 14, taken from the north side of the stream, shows the buildings indicated on Plate 1. Photograph 13, taken from the south side of the stream looking north, shows a building not shown on Plate 1. Four sheds and buildings are within three feet above the stream bank along the road, including two houses. Upon failure during one-half the PMF, some but not all of these buildings will be flooded. Computed maximum water levels of the downstream section within Hopewell Village

indicate a 2.4 foot increase in water elevation resulting from failure during one-half the PMF over nonfailure during one-half the PMF. The flood wave resulting from failure is judged to significantly increase property damage and the potential for loss of life.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations. Visual observations detected no evidence of potential instability of the dam or its components. The downstream slopes are reasonably uniform, with no signs of significant erosion or sloughing. Foot traffic paths were noted on both sides of the spillway. Woody vegetation is beginning to develop on the slopes, but reportedly is scheduled to be removed this spring. The vegetation is in a dormant condition and is assessed to be in fair condition. The crest, although uneven, is protected by mine screenings, and is not damaged by foot traffic. The upstream slope and riprap are in good condition.

The spillway is judged to be in good condition. Seepage through the ogee weir and stilling basin walls is judged to represent a stable condition.

b. Design and Construction Data. All available documentation, drawings and data received from the Department of Environmental Resources, and supplemented by conversations with the French Creek State Park superintendent, were assessed and reviewed. A stability analysis of the spillway was included in the design drawings, but not of the embankment. Based on the lack of visual signs of significant deterioration, it is qualitatively assessed that the stability of the embankment is adequate if not overtopped.

c. Operating Records. An operation and maintenance manual for Hopewell Dam, French Creek State Park, dated February 1979, has been developed for this dam.

d. Post-Construction Changes. There is no record nor is there any evidence that any major modifications were made to this dam.

e. Seismic Stability. The dam is located in Seismic Zone 1. Normally it is considered that if a dam in this zone is stable under static loading conditions, it can be assumed safe for any expected earthquake conditions. As the dam is qualitatively assessed to be stable under static loading conditions, it can reasonably be assumed to be stable under seismic loading conditions.

SECTION 7
ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment.

a. Evaluation. Visual inspection and review of the design and construction documentation indicate that the dam and appurtenant structures of Hopewell Dam are in good condition, although the condition of the dormant vegetation appeared to be only fair at the time of the inspection.

In accordance with criteria established by Federal (OCE) Guidelines, the spillway design flood for this "Small" size dam and "High" hazard classification is one-half to the full Probable Maximum Flood (PMF). As the dam's total capacity is near the upper limit of the size classification and Hopewell Village is located at a narrow section of the floodplain, the selected spillway design flood is the full PMF. Hydrologic and hydraulic computations presented in Appendix D indicate the spillway is capable of passing approximately 33 percent of the PMF without overtopping the embankment. As the one-half PMF is estimated to cause failure of the structure and to significantly increase the potential for downstream damage, the spillway system of this structure is considered to be "Seriously Inadequate" and the dam is in an "unsafe, nonemergency" condition.

b. Adequacy of Information. The combined visual inspection, review of available data and simplified calculations presented in Appendix D were sufficiently adequate to determine that further investigations are required for this structure.

c. Urgency. It is recommended that the measures presented in Section 7.2 be implemented as specified.

7.2 Remedial Measures.

a. Facilities. It is recommended that the following measures be undertaken as soon as practical. Items (1) through (3) should be under the direction of a registered professional engineer experienced in the design and construction of dams.

(1) A study should be made to determine the best method of increasing the spillway capacity to meet current hydrologic/hydraulic criteria.

(2) The large trees on the embankment to the left of the spillway should be removed, and the long-term stability of the slope should be evaluated in the light of the decaying root systems.

(3) The embankment should be raised to the design elevation on the left side of the spillway, and the entire embankment crest should be leveled.

(4) As planned during the routine spring maintenance of the embankment, the woody vegetation should be removed. It is recommended that the written operation and maintenance manual be expanded to include procedures for maintenance of embankment vegetation.

(5) The mortar joints in the spillway should be repaired.

b. Operation and Maintenance Procedures. Because of the location of the dam upstream of the Hopewell Village National Historic Site and the potential to cause extreme property damage and possible loss of life in the event of failure, a formal procedure of observation and warning during periods of high precipitation should be developed and implemented. This procedure should include a method of warning downstream personnel if high flows are expected and provisions for evacuating these people in the event of an emergency. It is recommended that the operation and maintenance manual be expanded to include procedures for the maintenance of the embankment vegetation. It is also recommended that errors in the manual with respect to the physical features of the dam be corrected.

APPENDIX

A

CHECK LIST
VISUAL INSPECTION
PHASE I

Name Dam *Hopewell Dam* County *Berks* State *Pennsylvania* National ID # *PA 00724*

Type of Dam *Earth* Hazard Category *High*

Date(s) Inspection *3/20/80* Weather *Partly sunny* Temperature *40's*

Pool Elevation at Time of Inspection *505.0* M.S.L. Tailwater at Time of Inspection *482.0* M.S.L.

Inspection Personnel:

Mary F. Beck (Hydrologist)
Arthur H. Dvinoff (Geotechnical/Civil)
Raymond S. Lambert (Geologist)
Vincent McKeever (Hydrologist)
John H. Frederick (Geotechnical/Civil) (4/9/80)

Mary F. Beck Recorder

Remarks:

Mr. Donald Clewell, Park Superintendent, was on site and provided assistance to the inspection team. Four park employees were also on site to operate the pond drain gate.

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	*N/A*	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	*N/A*	
DRAINS	*N/A*	
WATER PASSAGES	*N/A*	
FOUNDATION	*N/A*	

CONCRETE/MASONRY DAMS

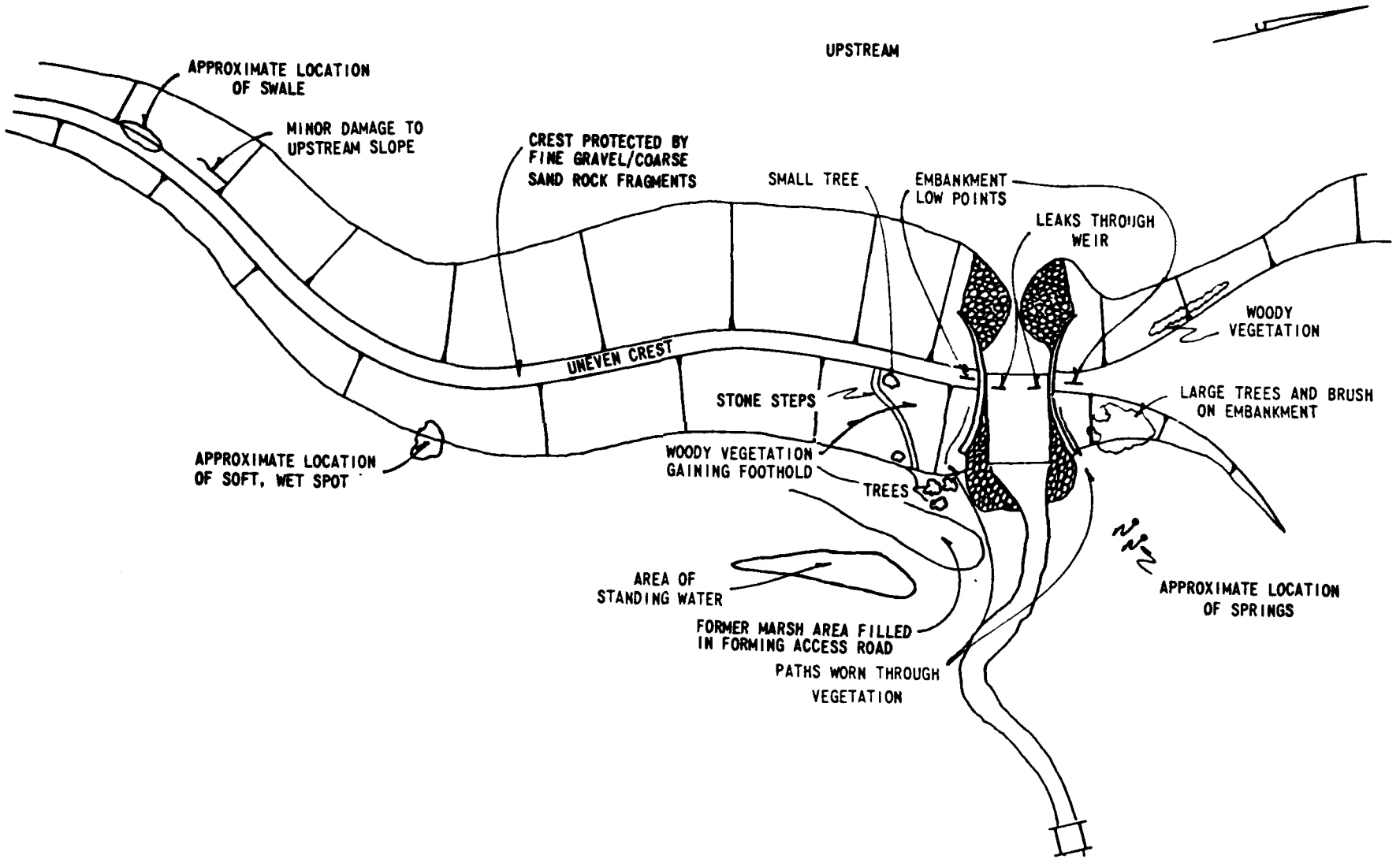
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	*N/A*	
STRUCTURAL CRACKING	*N/A*	
VERTICAL AND HORIZONTAL ALIGNMENT	*N/A*	
MONOLITH JOINTS	*N/A*	
CONSTRUCTION JOINTS	*N/A*	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	*None observed.*	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	*None observed. Both upstream and downstream sides of the embankment have a variable slope, steeper near the crest (about 3H:1V). The lower portion of the downstream slope is "hummocky"*	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	*Very minor sloughing/erosion/damage is on both upstream and downstream slopes near the right end. Downstream damage has either been repaired or was of a limited depth. The upstream crest edge near the right abutment has an old (well vegetated) swale, a type caused by foot traffic.*	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	*Horizontal alignment is satisfactory. The crest is not level, either parallel to dam centerline or perpendicualr to the centerline. See Sheet 5B. A portion of the crest is below the design elevation.*	
RIPRAP FAILURES	*None, the hand-placed riprap is generally good condition. Some riprap was displaced near the right spillway wall.*	

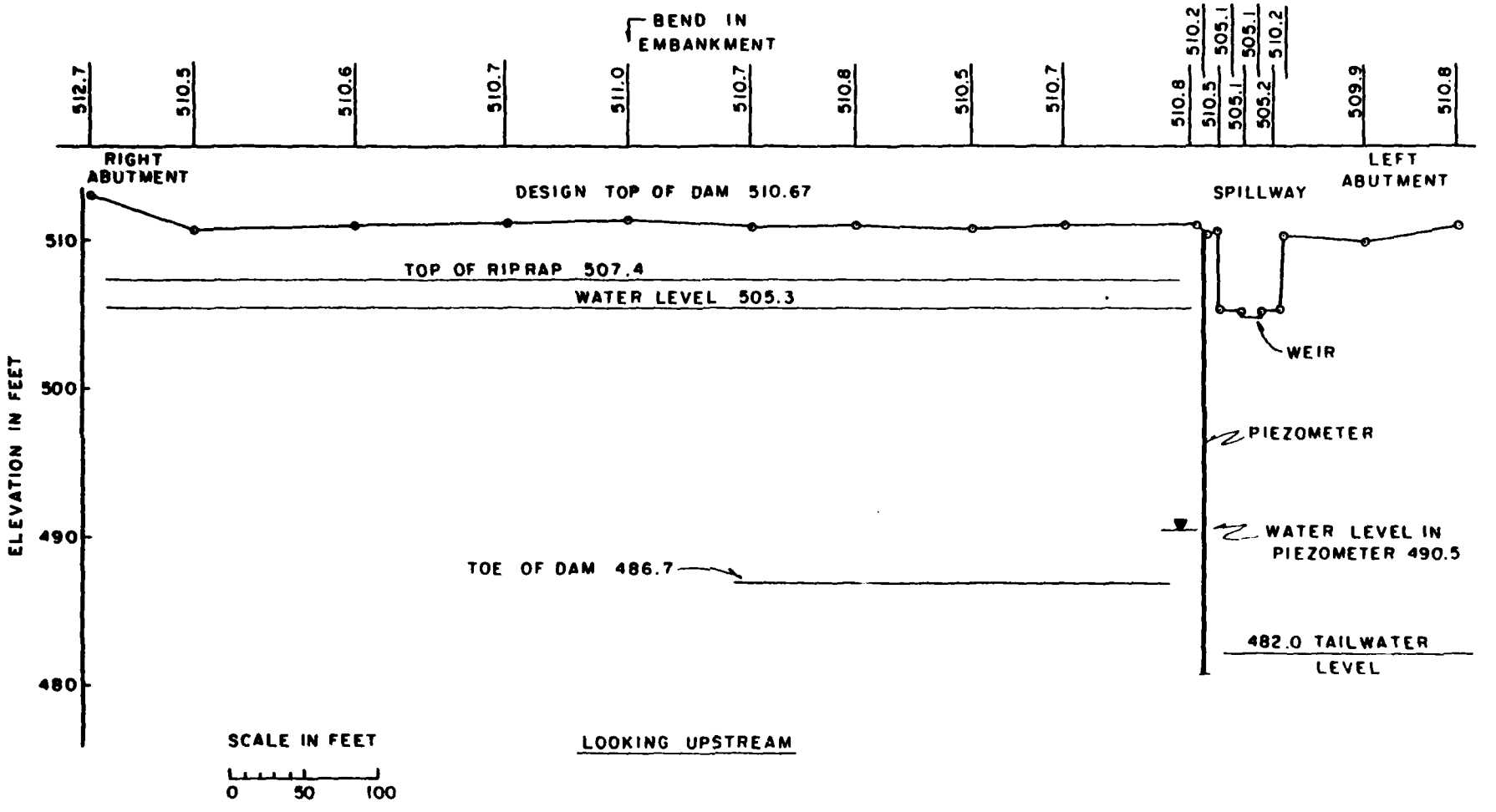
EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATION	*Vegetation was in a dormant state at the time of inspection. Vegetation on the upstream slope is grass. The crest is protected with mine screenings, coarse sand/fine gravel size rock fragments. There are two cedar trees on the downstream slope. Vegetation near the maximum section includes grass, woody vegetation (sumac), Crownvetch and briars.*	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	*All junctions are in good condition. The downstream junction between the embankment and righ abutment is a paved stone gutter. Junctions between the spillway and abutment and spillway and embankment are in good condition except foot traffic has worn paths through the vegetation.*	
ANY NOTICEABLE SEEPAGE	*Yes, see Sheet 5A.*	
STAFF GAGE AND RECORDER	*None. Staff gages to be installed.*	
DRAINS	*None observed.*	



FIELD OBSERVATION PLAN
HOPEWELL DAM

SHEET 5A OF 11



FIELD OBSERVATION PROFILE
HOPEWELL DAM
SHEET 5B OF 11

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	*30 inch conduit not inspected.*	
INTAKE STRUCTURE	*Completely underwater.*	
OUTLET STRUCTURE	*None, conduit discharges into spillway stilling basin.*	
OUTLET CHANNEL	*None.*	
EMERGENCY GATE	*Seats completely. A platform of concrete blocks and planks is constructed to operate gate.*	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	*The concrete weir is faced with stone. The upper 4 feet is faced with small stones and is fairly smooth. Below that are large stones forming steps up to 2 feet high. Water is exiting the stone face. Mortared joints have been repaired. Only two small holes were located in mortared joints.*	
APPROACH CHANNEL	*None.*	
DISCHARGE CHANNEL	*Spillway discharges into a large stilling basin. Spillway retaining walls are stone faced concrete. Water was exiting the stone face of both retaining walls. Water staining was evident to nearly the top of the walls.*	
BRIDGE AND PIERS	*None*	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	*N/A*	
APPROACH CHANNEL	*N/A*	
DISCHARGE CHANNEL	*N/A*	
BRIDGE AND PIERS	*N/A*	
GATES AND OPERATION EQUIPMENT	*N/A*	

INSTRUMENTATION

	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VISUAL EXAMINATION		
MONUMENTATION/SURVEYS	*None*	
OBSERVATION WELLS	*Six observation wells shown on design drawings; only one, on the crest near the spillway, was located. The water level at the time of inspection was 20 feet below the crest. The total dpeth of the wall is 30 feet.*	
WEIRS	*None*	
PIEZOMETERS	*None*	
OTHER	*None*	

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	*None*	
OBSERVATION WELLS	*Six observation wells shown on design drawings; only one, on the crest near the spillway, was located. The water level at the time of inspection was 20 feet below the crest. The total depth of the well is 30 feet.*	
WEIRS	*None*	
PIEZOMETERS	*None*	
OTHER	*None*	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	*Reservoir side slopes are flat to moderate and well vegetated to waters edge with trees. Little debris was noted.*	
SEDIMENTATION	*Very little sediment was noted at the upper end. Sediment accumulation has little or no effect on flood water storage.*	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	*Immediately below the dam, the 20 foot wide channel flows through a wooded flood plain to Hopewell Village.*	
SLOPES	*The valley gradient is about 0.01 below the dam.*	
APPROXIMATE NO. OF HOMES AND POPULATION	*The main damage center is about 1200 feet downstream of the dam in Hopewell Village, a National Historic Site. In addition to the appreciable economic damage to historic buildings in the event of failure, the Park Superintendent lives in a house which is a few feet above the stream bank.*	

APPENDIX

B

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM *Hopewell Dam*

ID # *PA 00724*

ITEM	REMARKS
AS-BUILT DRAWINGS	*None available.*
REGIONAL VICINITY MAP	*See Plate 1, Appendix E.*
CONSTRUCTION HISTORY	*See text, Section 1.2*
TYPICAL SECTIONS OF DAM	*See Appendix E.*
OUTLETS - PLAN	
DETAILS	*See Appendix E.*
CONSTRAINTS	
DISCHARGE RATINGS	*See Appendix D.*
RAINFALL/RESERVOIR RECORDS	*None*

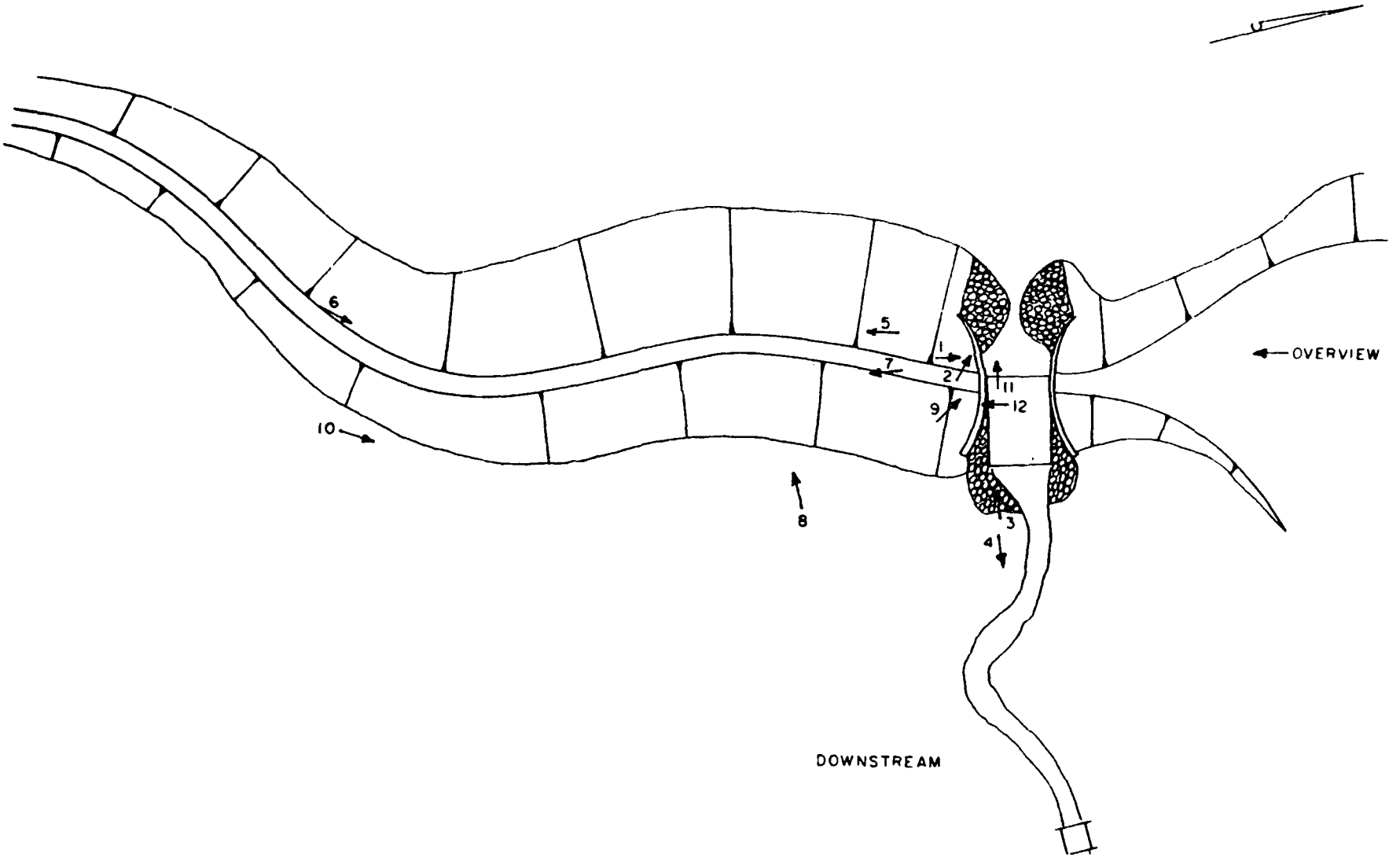
ITEM	REMARKS
DESIGN REPORTS	*None available.*
GEOLOGY REPORTS	*See Appendix F.*
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	*Spillway stability, see Appendix E.* *Hydrology and hydraulics, see Appendix D for discussion.*
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	*See text, Section 1.2*
POST-CONSTRUCTION SURVEYS OF DAM	*None*
BORROW SOURCES	*Two borrow pits were reportedly used. One borrow pit was 300 feet upstream of the dam on the left slope of the reservoir basin and the other was located about two miles from the dam.*

ITEM	REMARKS
MONITORING SYSTEMS	*Original design specified observation wells in the embankment. Only one located.*
MODIFICATIONS	*None known.*
HIGH POOL RECORDS	*None*
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	*None known.*
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	*None known.*
MAINTENANCE OPERATION RECORDS	*None*

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	*See Appendix E.*
OPERATING EQUIPMENT PLANS & DETAILS	*Shown on plans.*
MISCELLANEOUS	*DER files containing:* 1. *Design drawings.* 2. *Correspondence, memoranda, progress reports.* 3. *Inspection reports.* 4. *117 black and white photographs taken between 1936 and 1973.* 5. *Operation and Maintenance Manual (Bureau of State Parks).*

APPENDIX

C

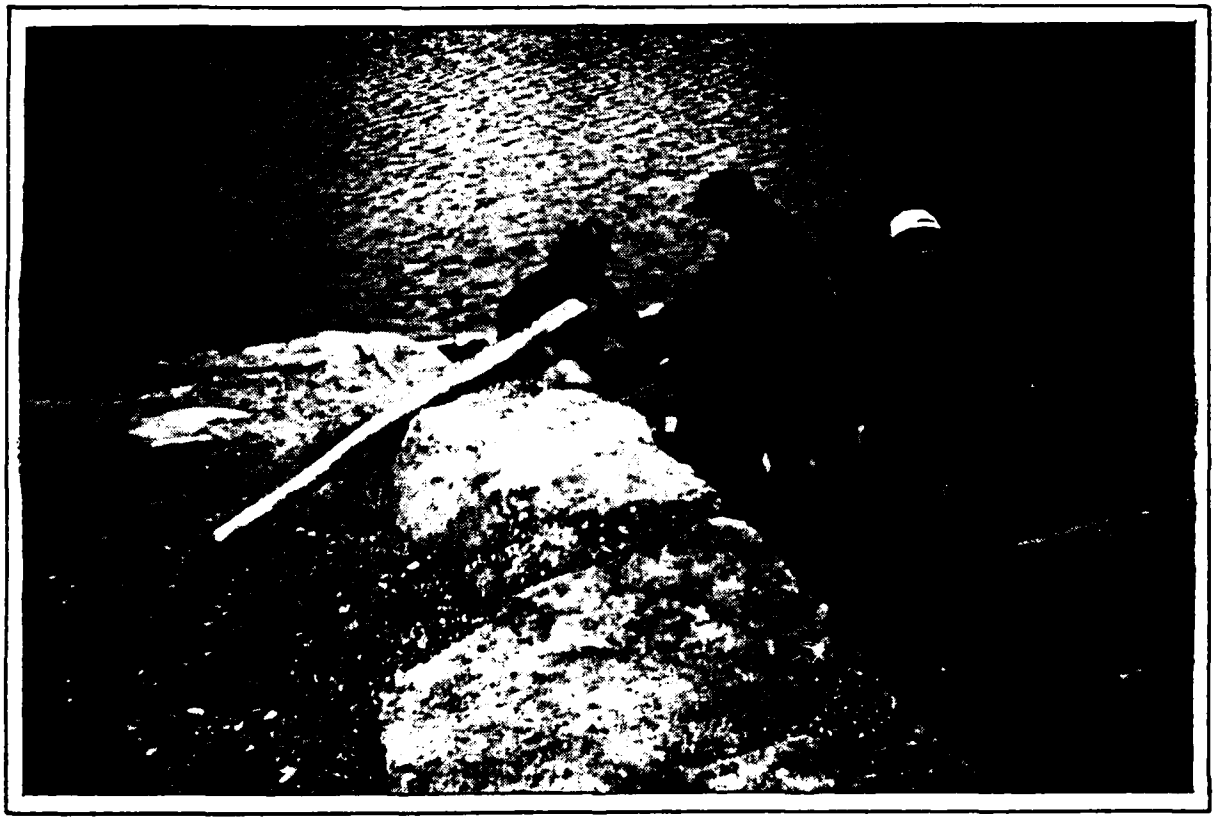


PHOTOGRAPH LOCATION PLAN
HOPEWELL DAM

PLATE C-1

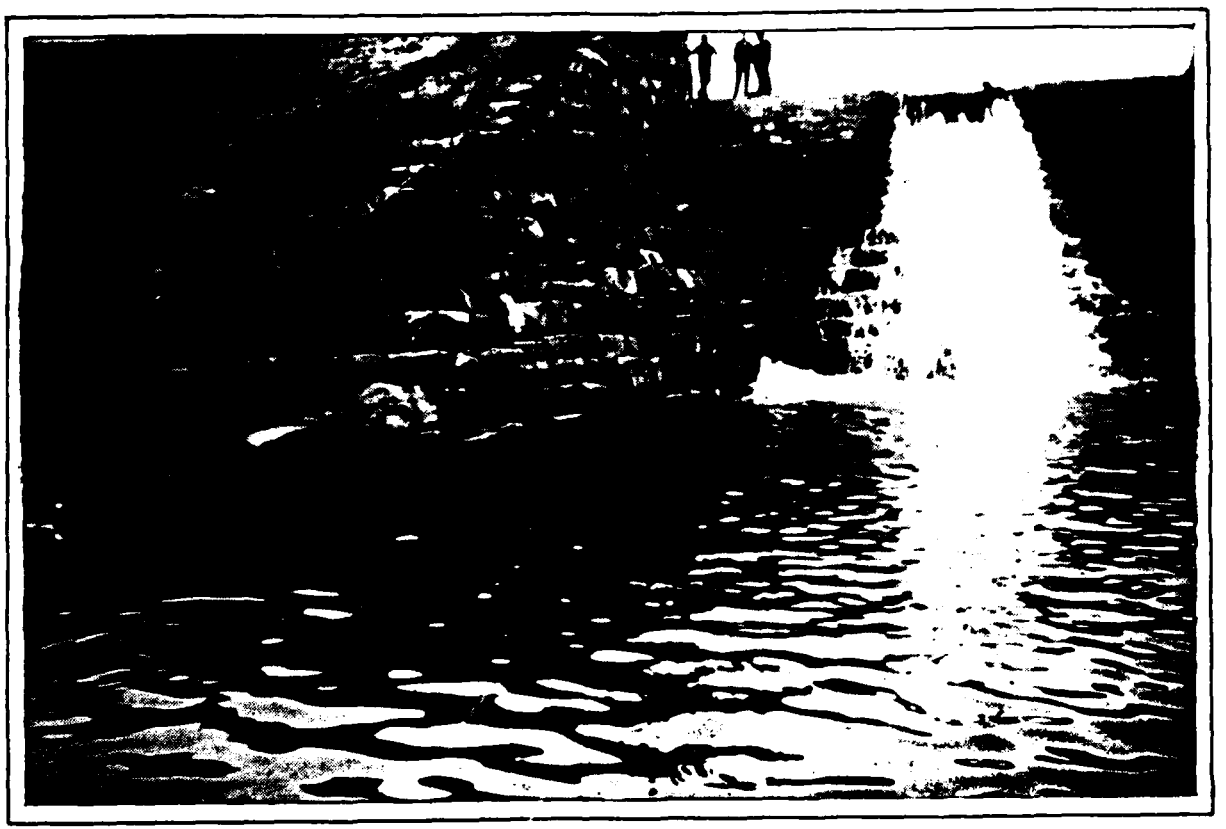
UPPER PORTION OF WEIR, SMALL
STONES USED FOR FACING TO
PROVIDE UNIFORM SHAPE.

PHOTOGRAPH NO. 1



PLATFORM CONSTRUCTED ON OUTLET STRUCTURE UPSTREAM OF WEIR TO STAND ON WHILE OPERATING POND DRAIN GATE.

PHOTOGRAPH NO. 2



WEIR AND STILLING BASIN. NOTE LARGE FACING STONES CREATING STEPS ON FACE OF WEIR. ALSO NOTE DISCHARGE FROM POND DRAIN AT BOTTOM LEFT OF SPILLWAY DISCHARGE.

PHOTOGRAPH NO. 3

STILLING BASIN.

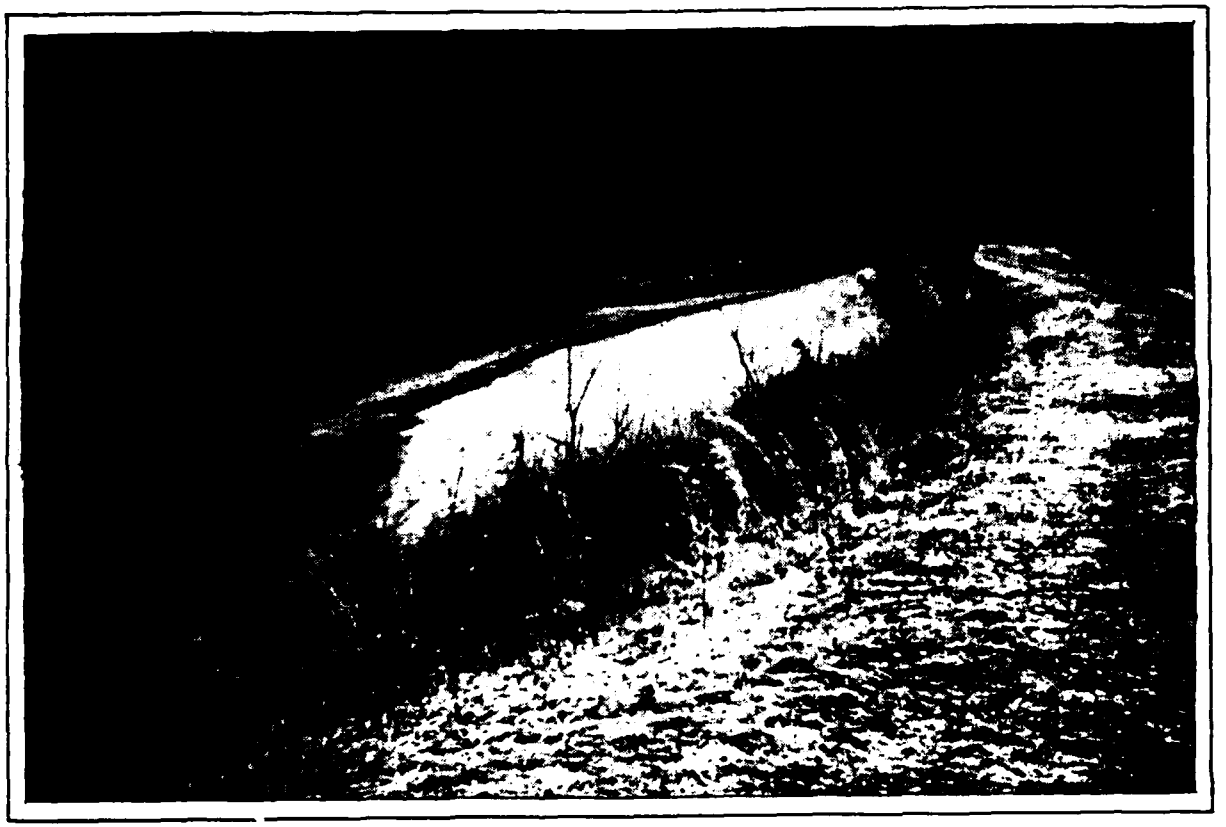
PHOTOGRAPH NO. 4

UPSTREAM SLOPE.

PHOTOGRAPH NO. 5

CREST AND OVERALL VIEW OF DOWNSTREAM SLOPE.

PHOTOGRAPH NO. 6



TREES, BRIARS AND WOODY VEGETATION
ON DOWNSTREAM SLOPE.

PHOTOGRAPH NO. 7

STONE STEPS ON DOWNSTREAM SLOPE.

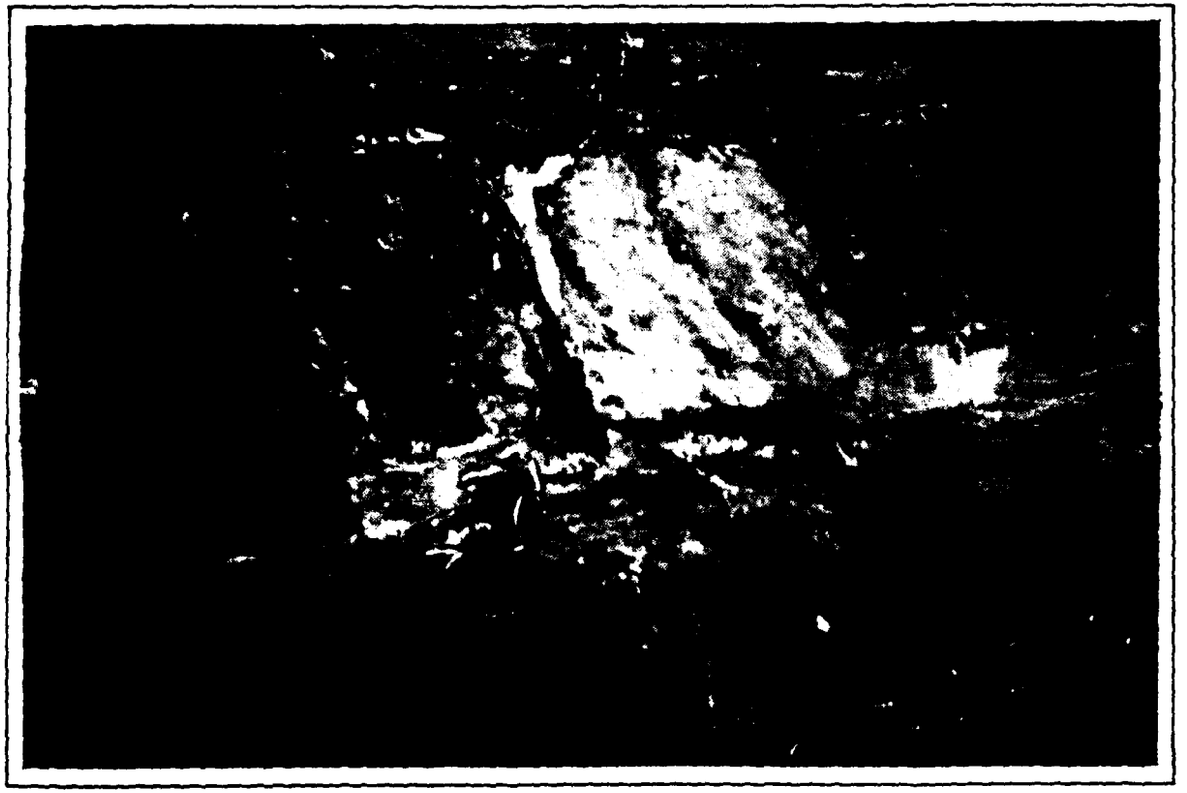
PHOTOGRAPH NO. 8

WATER OBSERVATION PIPE WITH
CAP OFF.

PHOTOGRAPH NO. 9

LOCATION OF STANDING WATER AND SOFTER EMBANKMENT ON DOWNSTREAM SLOPE.

PHOTOGRAPH NO. 10



LEAKAGE THROUGH WEIR BETWEEN NOTCH
AND RIGHT RETAINING WALL.

PHOTOGRAPH NO. 11

LEACHATE AS A RESULT OF
SEEPAGE THROUGH RIGHT
STILLING BASIN WALL.

PHOTOGRAPH NO. 12

DOWNSTREAM DAMAGE CENTER AT HOPEWELL VILLAGE.

PHOTOGRAPH NO. 13

ANOTHER VIEW OF THE BUILDING SHOWN
IN PHOTOGRAPH NO. 13.

PHOTOGRAPH NO. 14

ONE OF THE BUILDINGS IN THE BACKGROUND
IS AN OCCUPIED RESIDENCE.

PHOTOGRAPH NO. 15

APPENDIX

D

HOPEWELL DAM
CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: *80% wooded, 1% residential development upstream of dam.*

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): *505.0 feet (569 Acre-Feet).*

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): *509.9 feet (943 Acre-Feet).*

ELEVATION MAXIMUM DESIGN POOL: ---

ELEVATION TOP DAM: *509.9 feet.*

SPILLWAY

a. Elevation *505.0 feet.*

b. Type *Stone faced concrete ogee weir*

c. Width *42 feet.*

d. Length --

e. Location Spillover *Near left abutment.*

f. Number and Type of Gates *None*

OUTLET WORKS:

a. Type *30 inch conduit gated upstream of weir.*

b. Location *Through spillway adjacent to right retaining wall.*

c. Entrance inverts *483 feet.*

d. Exit inverts *483- feet.*

e. Emergency draindown facilities *through outlet works.*

HYDROMETEOROLOGICAL GAGES:

a. Type *None within watershed, rainfall measured at Hopewell Village.*

b. Location ----

c. Records ----

MAXIMUM NON-DAMAGING DISCHARGE: *Not determined.*

HYDROLOGIC AND HYDRAULIC
BASE DATA

DRAINAGE AREA:(1) *Scott's Run, 1.0 square mile; Hopewell, 1.56 square miles; 2.56 square miles total.*

PROBABLE MAXIMUM PRECIPITATION (PMP)
FOR 10 SQ. MILES IN 24 HOURS:(2) *23.5 inches.*

ADJUSTMENT FACTORS FOR DRAINAGE AREA (%):(3)

Zone	*6*
6 Hours	*113*
12 Hours	*123*
24 Hours	*132*
48 Hours	*142*

SNYDER HYDROGRAPH PARAMETERS:(4)

	Scott's Run Dam	*Hopewell Dam*
Zone	*7**	*7*
C_p, C_t	*0.65*, 1.35**	*0.65, 1.35*
L(5)	*1.2 miles**	L^1 *= 1.52 miles***
Lca (6)	*0.4 mile**	
$tp=C_t (L \cdot Lca)^{0.3}$	*1.1 hr.**	$tp = C_t (L^1)^{0.6}$ *= 1.73*

SPILLWAY CAPACITY AT MAXIMUM
WATER LEVEL(7)

Hopewell Dam - 1747 cfs

(1) Measured from USGS maps.
(2) Hydrometerological Report No. 33, Figure 1.
(3) Hydrometerological Report No. 33, Figure 2.
(4) Information received from Corps of Engineers, Baltimore District.
(5) Length of longest water course from outlet to basin divide, measured from USGS maps.
(6) Length of water course from outlet to point opposite the centroid of drainage area, (see Plate 1, Appendix E) measured from USGS maps.
(7) See Sheets 5, 14 of this Appendix.

* *Values obtained from Phase I Inspection Report, Scott's Run Lake Dam, July, 1979*

** L^1 *= length from upper end of reservoir to watershed divide, used when watershed centroid within or very near reservoir.*

HEC-1, REVISED
FLOOD HYDROGRAPH PACKAGE

The original "Flood Hydrograph Package" (HEC-1), developed by the Hydrologic Engineering Center, Corps of Engineers, has been modified for use under the National Dam Inspection Program. The "Flood Hydrograph Package (HEC-1), Dam Safety Version", hereinafter referred to as, HEC-1, Rev., has been modified to require less detailed input and to include a dam breach analysis. The required input is obtained from the field inspection of a dam, any available design/evaluation data, relatively simple hydraulic calculations, or information from the USGS Quandrangle maps. The input format is flexible in order to reflect any unique characteristics of an individual dam.

HEC-1, Rev. computes a reservoir inflow hydrograph based on individual watershed characteristics such as: area, percentage of impervious surface area, watershed shape, and hydrograph characteristics determined from regional correlation studies by the Corps of Engineers, Baltimore District. The inflow is routed through the reservoir using spillway discharge data obtained from the field inspection or design data. Flood storage capacity is determined from USGS maps or design information and verified by the field inspection. In the event a spillway cannot discharge 0.5 PMF without overtopping and failure of the dam, downstream channel characteristics obtained from the field inspection and USGS maps are inputed and flows are routed downstream to the damage center and a dam breach analysis is performed.

Included in this Appendix are the HEC-1, Rev. pertinent input values and a summary print-out tables.

Classification (Ref - Recommended Guidelines for Safety Inspection of Dams)

1. The hazard potential is rated as "High" as there would be loss of life if the dam failed

2. The size classification is "Small" based on its 26 ft. height and 943 Ac-Ft total storage capacity

3. The selected spillway design flood, based on size and hazard classification is the Probable Maximum Flood (PMF).

Hydrology and Hydraulic Analysis

1. Original / Evaluation Data

Spillway - designed as ogee weir

$Q = C_o L H_o^{3/2}$

$L = 42$ ft.

$H_o = 4.67$ ft, design head

$C_o = 3.95$

- calculations indicate spillway can discharge a 10 hr event of 0.96 in./hr or 8.3 inches of runoff.

Scott's Run Dam - Phase I Inspection, July 1975.

Inflow hydrograph parameters, elevation - storage data and spillway discharge characteristics obtained from report

2. Evaluation of Data

Inflow hydrograph parameters shown on sheet 2.

Reservoir Routing

elevation - storage data, obtained from 12/11/35 drawing and shown on Plate 1 of Hopewell Dam O & M manual enclosed as sheet 6. Normal pool area verified by current USGS map. Flood storage estimated from USGS map.

elevation - discharge data. Ogee weir design head is 4.67 ft. The reported coefficient of discharge, C_o, of 3.95 corresponds to a height of weir above upstream full, P, of 11.6 ft. (Ref - Design of Small Dams, 2nd., 1973, Bureau of Reclamation).

As P = 2.3' (reported during construction), C of weir is reduced; $C_o = 3.8$

W.S.	H_e	H_{ef}/H_e	C/C_o	C_o	L	Q	
505.0	0	0				0	
506.0	1	0.21	0.85	3.80	42'	135 cfs	✓
507.0	2	0.43	0.89			406	✓
508.0	3	0.64	0.94			780	✓
509.0	4	0.86	0.98			1251	✓
510.0	5	1.07	1.01			1802	✓
511.0	6	1.28	1.03			2416	✓
513.0	8	1.71	1.07			3864	✓

Overtopping - as shown on sheet 14, the embankment is overtopped by 1.2 ft during the 0.5PMF event and by 2.6 ft during the PMF.

Overtopping is assessed to cause failure if the embankment is overtopped by about one foot for more than one hour, say 0.8 ft.

Increase in downstream damage, discharge from dam routed downstream to Hopewell Village Historic Site. An estimated 2.4 ft increase in water level resulting from failure during 0.5PMF over non-failure during the 0.5 PMF is assessed to significantly increase the potential for damage. Buildings shown in Photos 13,14 are at about elevation 479.5.

Spillway Adequacy - the spillway is rated as "Seriously Inadequate"

DEPARTMENT OF FORESTS AND WATERS—DIVISION OF FLOOD CONTROL

SUBJECT HOPEWELL DAM — FILE NO.

FRENCH CREEK STATE PARK — SECTION NO.

SHEET 6 OF 15 — SHEET NO.

COMPUTED BY — CHECKED BY — DATE

MADE IN CONNECTION WITH

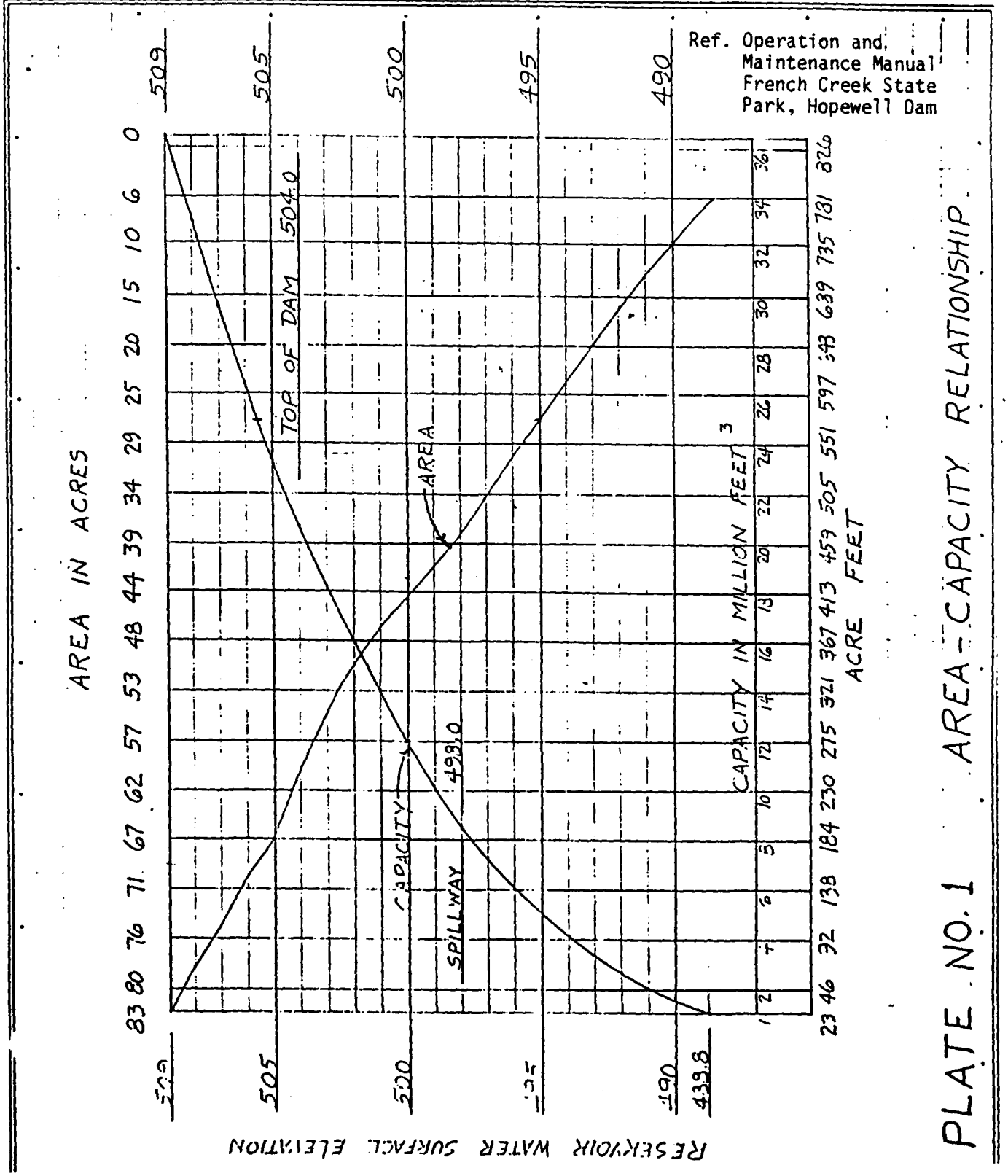


PLATE NO. 1 AREA-CAPACITY RELATIONSHIP

```
1**********************************
 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION      JULY 1978
   LAST MODIFICATION  26 FEB 79
 **********************************

 RUN  DATE* 80/04/02.
      TIME* 10.31.21.
```

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT	SRIN
ROUTE HYDROGRAPH TO	SROU
ROUTE HYDROGRAPH TO	CHA
RUNOFF HYDROGRAPH AT	HUIN
COMBINE 2 HYDROGRAPHS AT	COM
ROUTE HYDROGRAPH TO	OUT
ROUTE HYDROGRAPH TO	DS1
ROUTE HYDROGRAPH TO	DS2
END OF NETWORK	

HOPEWELL DAM
NAT ID NO. PA 00724 DER NO. 6-401
OVERTOPPING ANALYSIS

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
200	0	15	0	0	0	0	0	-4	0
			JOPER	NWT	LROPT	TRACE			
			5	0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 5 LRTIO= 1

RTIOS= .20 .30 .40 .50 1.00

SHEET 7 OF 15

SUB AREA RUNOFF COMPUTATION

SCOTTS RUN INFLOW HYDROGRAPH

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
SKIN	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	1.00	0.00	2.56	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PRS	R6	R12	R24	R48	R72	R96
0.00	23.50	113.00	123.00	132.00	142.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMI	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 1.10 CP= .65 NTA= 0

RECESSION DATA

STRTQ= -1.56 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 23 END-OF-PERIOD ORDINATES, LAG= 1.11 HOURS, CP= .64 VOL= 1.00

36.	128.	245.	340.	377.	339.	264.	201.	154.	117.
90.	68.	52.	40.	30.	23.	18.	14.	10.	8.
6.	5.	3.							

0 END-OF-PERIOD FLOW

HO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	HO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	26.70	24.30	2.40	62855.
										(678.)(617.)(61.)(1779.86)			

HYDROGRAPH ROUTING

SCOTTS RUN OUTFLOW HYDROGRAPH

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
SROU	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-592.	0

SURFACE AREA=	0.	22.	46.
CAPACITY=	0.	198.	464.
ELEVATION=	565.	592.	600.

CREL	SPWID	COQW	EXPW	ELEVL	COOL	CAREA	EXPL
592.0	40.0	3.5	1.5	0.0	0.0	0.0	0.0

DAM DATA

IOPEL	COQD	EXPD	DAMWID
599.0	3.1	1.5	580.

HYDROGRAPH ROUTING

CHANNEL ROUTING BETWEEN SLOTTS RUN AND HOPEWELL

	ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
	CHA	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1		010000000	0	0

	NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
	1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0550	.0500	.0550	530.0	545.0	4000.	.01300

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 545.00 332.00 535.70 422.00 535.70 422.00 530.00 434.00 530.00
434.00 535.70 500.00 536.00 595.00 545.00

STORAGE	0.00	.87	1.74	2.61	3.48	4.35	5.22	6.09	15.54	30.88
	48.87	69.50	92.78	118.71	147.28	178.50	212.37	248.89	288.05	329.86
OUTFLOW	0.00	25.32	74.70	137.45	209.06	286.97	369.57	455.76	750.28	1538.01
	2757.24	4415.60	6535.33	9143.29	12267.99	15938.44	20183.64	25032.36	30513.00	36653.55
STAGE	530.00	530.79	531.58	532.37	533.16	533.95	534.74	535.53	536.32	537.11
	537.89	538.68	539.47	540.26	541.05	541.84	542.63	543.42	544.21	545.00
FLOW	0.00	25.32	74.70	137.45	209.06	286.97	369.57	455.76	750.28	1538.01
	2757.24	4415.60	6535.33	9143.29	12267.99	15938.44	20183.64	25032.36	30513.00	36653.55

SUB-AREA RUNOFF COMPUTATION

UNCONTROLLED AREA RUNOFF HYDROGRAPH INTO HOPEWELL LAKE

	ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
	HWIN	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	IRSDA	IRSPC	RATIO	ISNOW	ISARE	LOCAL
1	1	1.56	0.00	2.56	0.00	0.000	0	1	0

PRECIP DATA

	SPFE	PMS	R6	R12	R24	R48	R72	R96
	0.00	23.50	113.00	123.00	132.00	142.00	0.00	0.00

IRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 1.73 CP= .65 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 36 END-OF-PERIOD ORDINATES, LAG= 1.73 HOURS, CP= .65 VOL= 1.00

20.	73.	144.	226.	302.	356.	382.	375.	333.	281.
238.	201.	170.	143.	121.	102.	86.	73.	62.	52.
44.	37.	31.	26.	22.	19.	16.	13.	11.	10.
8.	7.	6.	5.	4.	3.				

0 END-OF-PERIOD FLOW

NO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	NO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q

SUM 26.70 24.30 2.40 97286.
(678.)(617.)(61.)(2754.83)

COMBINE HYDROGRAPHS

HOPEWELL INFLOW HYDROGRAPH

	ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
	COM	2	0	0	0	0	1	0	0

HYDROGRAPH ROUTING

HOPEWELL DAM OUTFLOW HYDROGRAPH

	ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
	OUT	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPRP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-505.	-1

STAGE	505.00	506.00	507.00	508.00	509.00	510.00	511.00	513.00
FLOW	0.00	135.00	406.00	780.00	1251.00	1802.00	2416.00	3864.00
SURFACE AREA=	0.	6.	27.	45.	68.	83.	87.	154.
CAPACITY=	0.	12.	119.	296.	603.	867.	952.	2141.
ELEVATION=	482.	488.	495.	500.	506.	509.	510.	520.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
505.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
509.9	0.0	0.0	0.

CREST LENGTH	0.	75.	117.	460.	540.
AT OR BELOW ELEVATION	509.9	510.2	510.6	510.7	512.0

HYDROGRAPH ROUTING

DOWNSTREAM SECTION 400 FT BELOW DAM

	ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
	D51	1	0	0	0	0	1	0	0
			ROUTING DATA						
QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP		LSTR	
0.0	0.000	0.00	1	1	0	0		0	
	NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT	
	1	0	0	0.000	0.000	0.000	0.	0	

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELMVT	ELMAX	RLNTH	SEL
.0550	.0500	.0550	478.0	491.0	400.	.01000

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 491.00 15.00 486.80 31.50 480.50 39.00 478.00 59.00 478.00
61.50 480.50 269.00 486.10 389.00 491.00

STORAGE	0.00	.13	.29	.45	.65	.98	1.49	2.17	3.02	4.04
	5.24	6.60	8.14	9.82	11.61	13.53	15.56	17.70	19.97	22.36
OUTFLOW	0.00	32.09	103.81	208.65	353.06	569.39	883.40	1323.31	1914.18	2677.62
	3634.48	4804.25	6219.24	7945.54	9915.11	12135.85	14616.05	17364.14	20388.66	23698.19
STAGE	478.00	478.68	479.37	480.05	480.74	481.42	482.11	482.79	483.47	484.16
	484.84	485.53	486.21	486.89	487.58	488.26	488.95	489.63	490.32	491.00
FLOW	0.00	32.09	103.81	208.65	353.06	569.39	883.40	1323.31	1914.18	2677.62
	3634.48	4804.25	6219.24	7945.54	9915.11	12135.85	14616.05	17364.14	20388.66	23698.19

HYDROGRAPH ROUTING

DOWNSTREAM SECTION 1200 FT BELOW DAM

	ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
	D52	1	0	0	0	0	1	0	0
			ROUTING DATA						
QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP		LSTR	
0.0	0.000	0.00	1	1	0	0		0	
	NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT	
	1	0	0	0.000	0.000	0.000	0.	0	

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELMVT	ELMAX	RLNTH	SEL
.0400	.0400	.0400	475.0	495.0	800.	.00700

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 495.00 25.00 479.50 140.00 479.50 145.00 475.00 153.00 475.00
158.00 479.50 375.00 481.50 660.00 495.00

STORAGE	0.00	.18	.40	.67	.98	3.53	8.84	15.80	23.24	31.14
	39.51	48.33	57.63	67.38	77.60	88.27	99.41	111.02	123.08	135.61
OUTFLOW	0.00	27.33	89.79	184.79	314.00	786.10	2238.29	4977.38	8813.95	13643.31
	19437.04	26186.02	33891.62	42561.55	52207.59	62844.24	74487.89	87156.29	100868.12	115642.78
STAGE	475.00	476.05	477.11	478.16	479.21	480.26	481.32	482.37	483.42	484.47
	485.53	486.58	487.63	488.68	489.74	490.79	491.84	492.89	493.95	495.00
FLOW	0.00	27.33	89.79	184.79	314.00	786.10	2238.29	4977.38	8813.95	13643.31
	19437.04	26186.02	33891.62	42561.55	52207.59	62844.24	74487.89	87156.29	100868.12	115642.78

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .20	RATIO 2 .30	RATIO 3 .40	RATIO 4 .50	RATIO 5 1.00
HYDROGRAPH AT	SRIN	1.00	1	745.	1118.	1491.	1864.	3727.
	(	2.59)	(	21.11)(	31.66)(	42.22)(	52.77)(	105.54)(
ROUTED TO	SROU	1.00	1	572.	875.	1179.	1482.	3313.
	(	2.59)	(	16.19)(	24.78)(	33.38)(	41.97)(	93.81)(
ROUTED TO	CHA	1.00	1	556.	861.	1163.	1463.	3226.
	(	2.59)	(	15.74)(	24.37)(	32.94)(	41.42)(	91.34)(
HYDROGRAPH AT	HUIN	1.56	1	932.	1398.	1864.	2330.	4659.
	(	4.04)	(	26.39)(	39.58)(	52.77)(	65.96)(	131.93)(
2 COMBINED	COM	2.56	1	1464.	2229.	3001.	3763.	7885.
	(	6.63)	(	41.47)(	63.13)(	84.97)(	106.55)(	223.27)(
ROUTED TO	OUT	2.56	1	1001.	1589.	2261.	3223.	7569.
	(	6.63)	(	28.35)(	45.00)(	64.03)(	91.26)(	214.34)(
ROUTED TO	DS1	2.56	1	1001.	1588.	2261.	3228.	7575.
	(	6.63)	(	28.35)(	44.98)(	64.01)(	91.41)(	214.49)(
ROUTED TO	DS2	2.56	1	1001.	1587.	2261.	3226.	7578.
	(	6.63)	(	28.34)(	44.94)(	64.02)(	91.36)(	214.59)(

SUMMARY OF DAM SAFETY ANALYSIS

SCOTT'S RUN DAM

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	592.00	592.00	599.00
STORAGE	198.	198.	420.
OUTFLOW	0.	0.	2593.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.20	594.56	0.00	263.	572.	0.00	41.50	0.00
.30	595.39	0.00	288.	875.	0.00	41.50	0.00
.40	596.14	0.00	312.	1179.	0.00	41.50	0.00
.50	596.82	0.00	335.	1482.	0.00	41.50	0.00
1.00	599.42	.42	438.	3313.	1.50	41.25	0.00

PLAN 1 STATION CHA

Channel routing between dams

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	556.	535.8	42.00
.30	861.	536.4	41.75
.40	1163.	536.7	41.75
.50	1463.	537.0	41.75
1.00	3226.	538.1	41.25

SUMMARY OF DAM SAFETY ANALYSIS

HOPEWELL DAM

No Failure

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	505.00	505.00	509.90
STORAGE	569.	569.	943.
OUTFLOW	0.	0.	1747.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.20	508.47	0.00	823.	1001.	0.00	43.25	0.00
.30	509.61	0.00	918.	1589.	0.00	43.00	0.00
.40	510.58	.68	1003.	2261.	3.00	42.75	0.00
.50	511.13	1.23	1054.	3223.	4.00	42.50	0.00
1.00	512.45	2.55	1183.	7569.	6.50	41.75	0.00

PLAN 1 STATION DS1

Section 400 ft. below Hopewell Dam

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	1001.	482.3	43.25
.30	1588.	483.1	43.00
.40	2261.	483.8	42.75
.50	3228.	484.6	42.50
1.00	7575.	486.7	41.75

PLAN 1 STATION DS2

Section 1200 ft. below Hopewell Dam

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	1001.	480.4	43.25
.30	1587.	480.8	43.25
.40	2261.	481.3	43.00
.50	3226.	481.7	42.50
1.00	7578.	483.1	41.75

SHEET 14 OF 15

SUMMARY OF DAM SAFETY ANALYSIS
HOPEWELL DAM
Failure assumed. No upstream failures.

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	505.00	505.00	509.90
STORAGE	569.	569.	943.
OUTFLOW	0.	0.	1747.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.20	508.47	0.00	823.	1001.	0.00	43.25	0.00
.30	509.61	0.00	918.	1589.	0.00	43.00	0.00
.40	510.58	.68	1003.	2261.	3.00	42.75	0.00
.50	510.95	1.05	1036.	12418.	1.16	42.25	41.75
1.00	511.22	1.32	1062.	13550.	1.28	40.75	40.25

PLAN 1 STATION DS1
Section 400 ft. below Hopewell Dam

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	1001.	482.3	43.25
.30	1588.	483.1	43.00
.40	2260.	483.8	42.75
.50	12279.	488.3	42.25
1.00	13425.	488.6	40.75

PLAN 1 STATION DS2
Section 1200 ft. below Hopewell Dam

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	1001.	480.4	43.25
.30	1587.	480.8	43.25
.40	2261.	481.3	43.00
.50	11879.	484.1	42.25
1.00	13055.	484.3	40.75

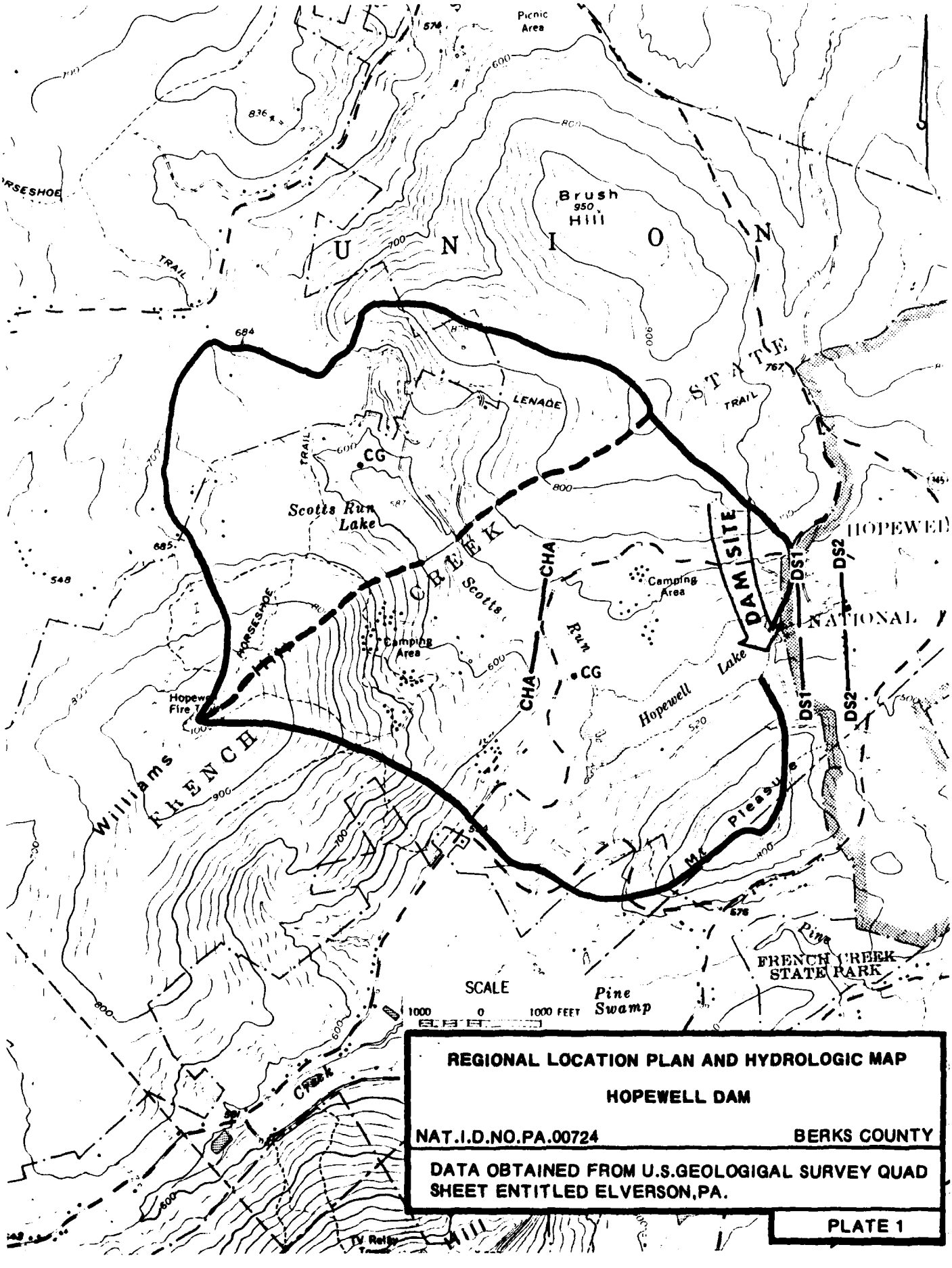
DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
30.	0.00	485.00	.50	505.00	510.70

SHEET 15 OF 15

APPENDIX

E



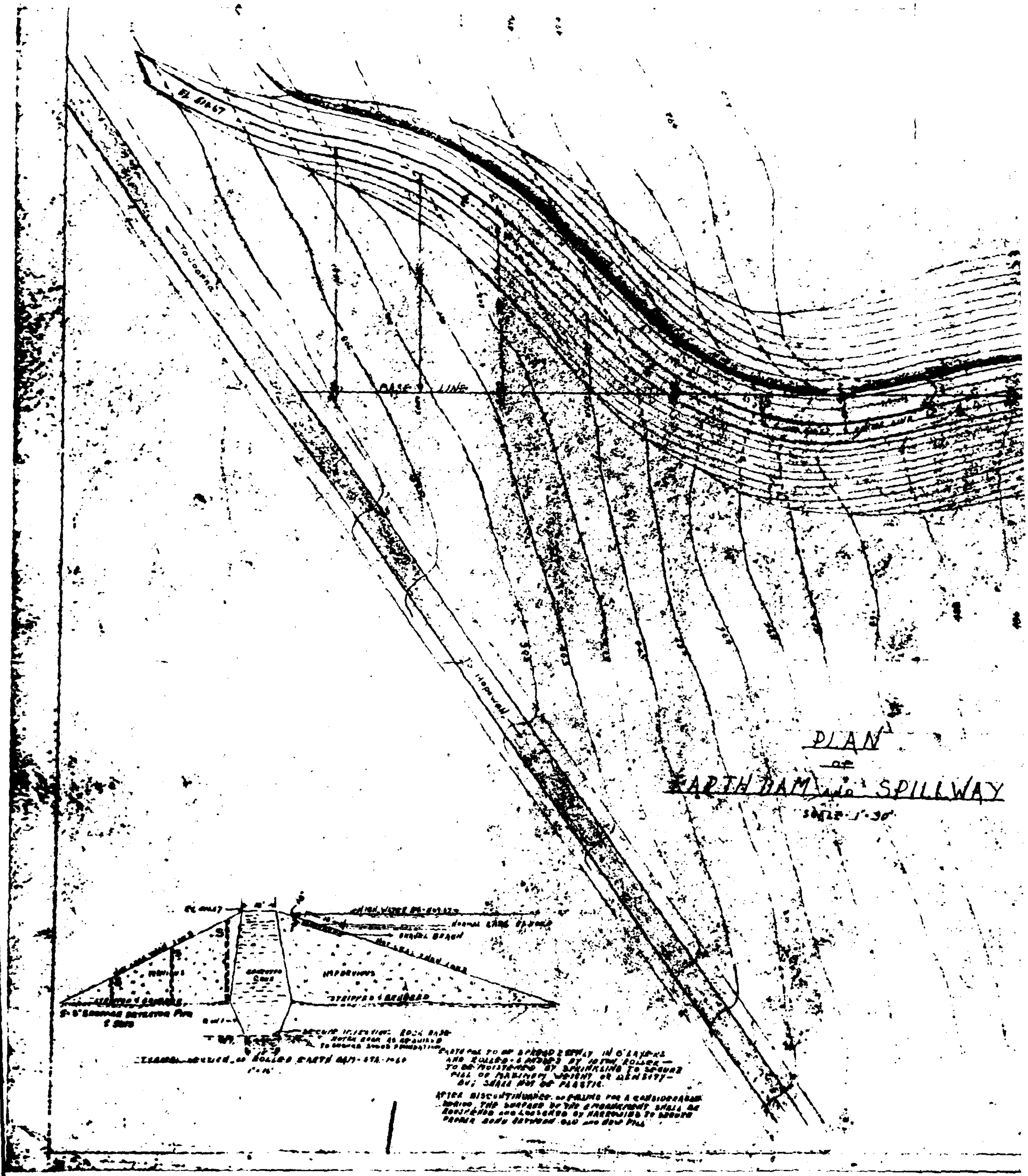
REGIONAL LOCATION PLAN AND HYDROLOGIC MAP

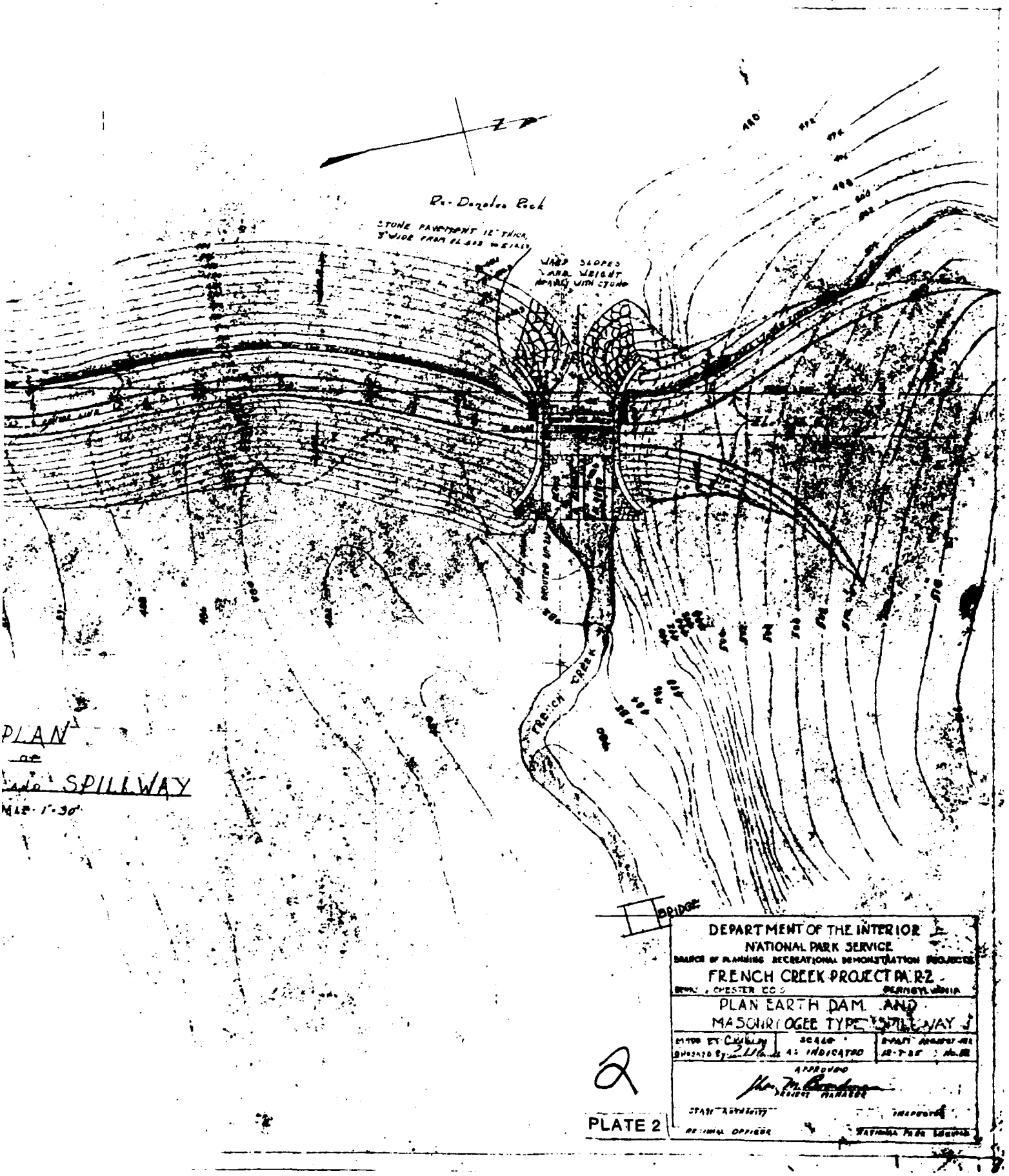
HOPEWELL DAM

NAT.I.D.NO.PA.00724 **BERKS COUNTY**

DATA OBTAINED FROM U.S.GEOLOGIGAL SURVEY QUAD SHEET ENTITLED ELVERSON,PA.

PLATE 1


BASE LINE
PLAN
of
EARTH DAM and SPILLWAY
IMPERVIOUS
STRIPPED & GRUBBED



PLAN
OF
SPILLWAY

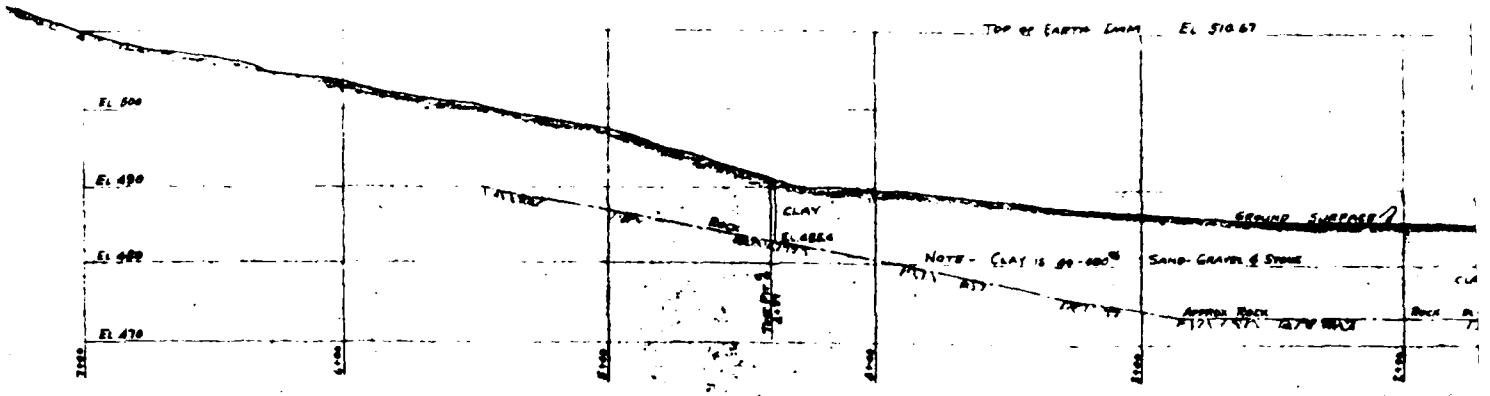
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
BUREAU OF PLANNING RECREATIONAL DEMONSTRATION PROJECTS
FRENCH CREEK PROJECT PA. R-2
CHESTER CO.'S PENNSYLVANIA
PLAN EARTH DAM AND MASONRY OGEE TYPE SPILLWAY
SCALE AS INDICATED

APPROVED
PROJECT MANAGER

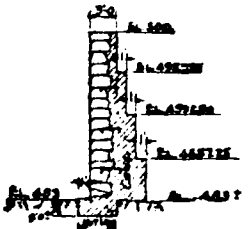
STATE AGENCY
REGIONAL OFFICER
INSPECTED
NATIONAL PARK SERVICE

2

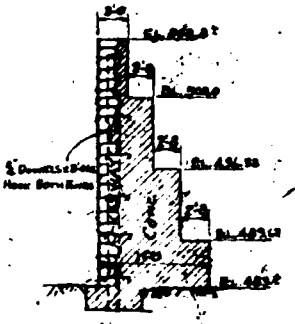
PLATE 2



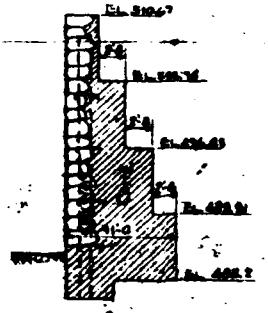
DOWNSTREAM PROFILE OF DAM
HOR. SCALE - 1" = 30'
VERT. SCALE - 1" = 10'



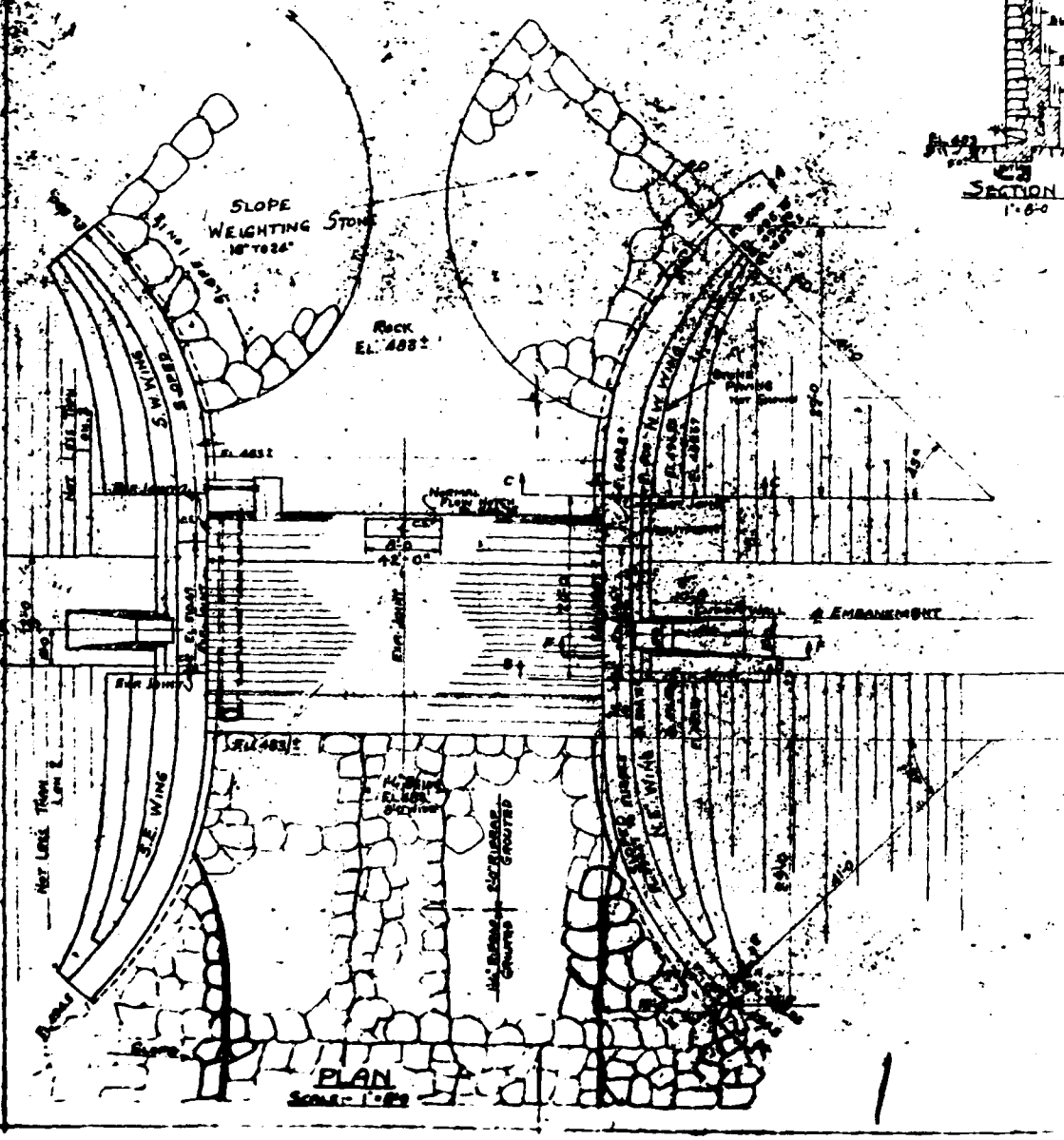
SECTION D-D
1" = 8'-0"

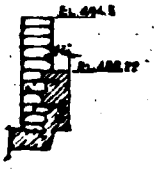


SECTION C-C
1" = 8'-0"

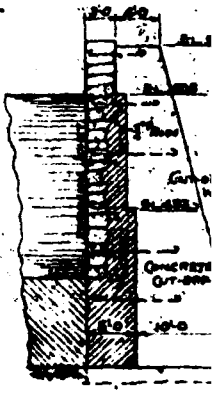


SECTION B-B
1" = 8'-0"
N.W. & S.E. WING WALL

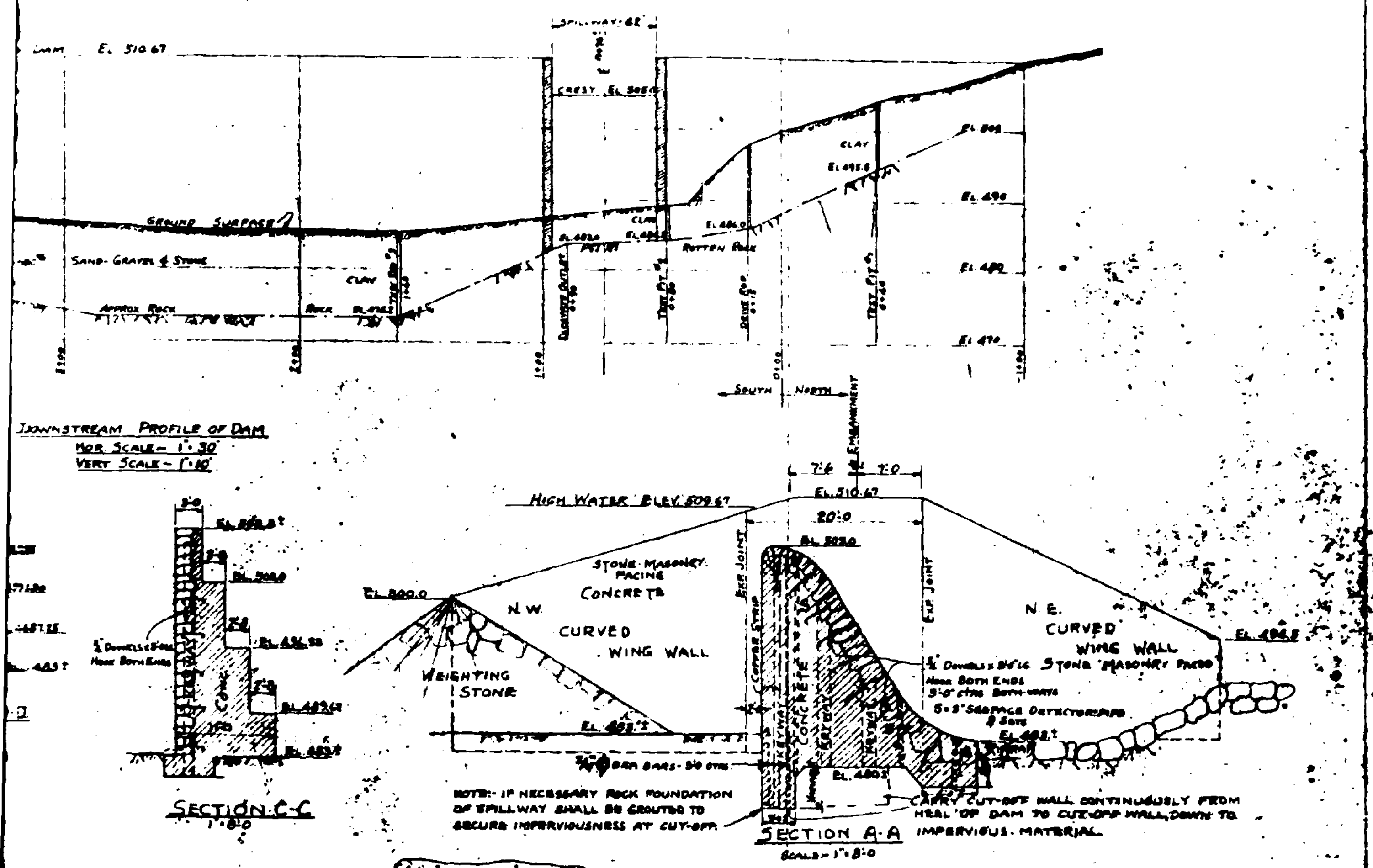


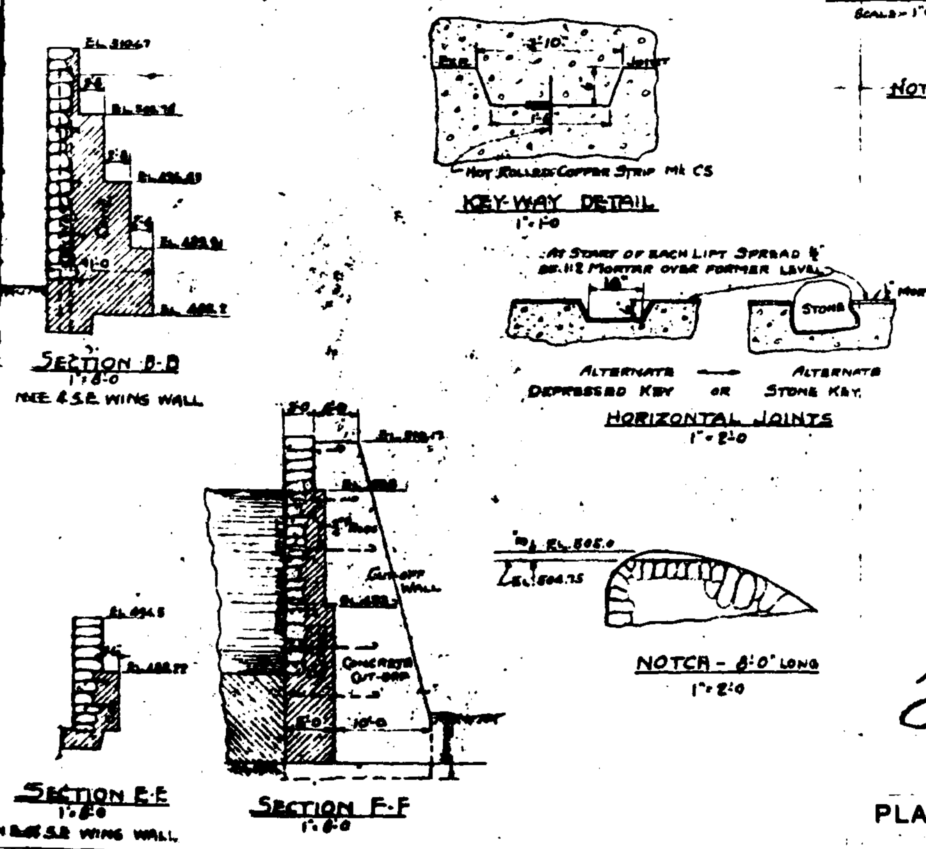


SECTION E-E
1" = 8'-0"
N.W. & S.E. WING WALL



SECTION F-F
1" = 8'-0"





NOTE:- CONCRETE TO BE MIXED 1:2:4 WITH 3 LBS CELITE PER SACK OF CEMENT - 6 GALS OF WATER PER SACK.
MORTAR FOR STONE MASONRY TO BE 1:2 MIX WITH 3 LBS CELITE PER SACK OF CEMENT.
"PLUMS" OF SOUND NATIVE STONE ARE TO BE DEPOSITED AS CONCRETING ADVANCES.
SURFACES OF EXPANSION JOINTS TO BE SWABBED 3 COATS ASPHALTIC EMULSION.
SLUSH GROUT FOR RIPRAP TO BE 1:3 MIX-CONCRETE TO BE USED FOR LARGER VOIDS.
STONE MASONRY FACES ARE INDICATED FOR ALL EXPOSED WORK. FACE APPEARANCE OF THIS MASONRY WILL BE CONTROLLED IN FIELD.
THE BASES OF STRUCTURES SHOWN ON THIS SHEET ARE APPROX. ONLY AND MAY BE ORDERED BY THE ENGINEER TO BE OF ANY DIMENSIONS OR AT ANY ELEVATIONS NECESSARY TO SECURE A PROPER FOUNDATION.
STONE MASONRY FACING IN ALL WALLS AND DAM TO BE CARRIED IN ADVANCE OF CONCRETE WHICH IS DEPOSITED BETWEEN MASONRY AND A BACK FORM.

DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
BRANCH OF PLANNING-RECREATIONAL DEMONSTRATION PROJECTS
FRENCH CREEK PROJECT PA.R-2
BERKS & CHESTER COS. PENNSYLVANIA

PROFILE OF EARTH DAM
SPILLWAY DETAILS

SCALE: AS SHOWN
PA. 17
12-10-35
No 58
PROJECT MANAGER
STATE AUTHORITY
INSPECTOR
REGIONAL OFFICER
NATIONAL PARK SERVICE

2

PLATE 3

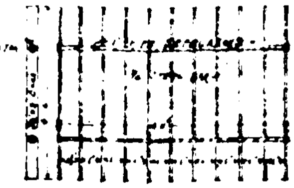
RESERVOIR EMPTY MASONRY [illegible] CASE I

BLOCK	WT. TONS	DISTANCE H FROM UPSTREAM FACE	WIDTH OF SECTION	INSIDE MID THIRD
ELEV 503 - ELEV 503	.38	1.89	5.00	0.17
" 502	1.03	2.56	6.85	0.28
" 499.67	5.78	4.39	11.80	0.46
" 497.33	13.93	5.87	16.[illegible]	0.47
" 490.0	[illegible].63	7.50	28.[illegible]0	0.17

WATER LOADS VERTICAL

NEGLECT WEIGHT OF TAILWATER

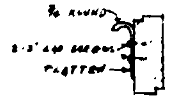
" " WATER ON CREST AND DOWNSTREAM FACE



SCREEN DETAIL

1" = 2'

1 REQ'D WT 220 LBS



LIFTING H[illegible]

RESERVOIR AT HIGH WATER - NO UPLIFT (CASE II)

BLOCK	W WT. TONS	DIST. FROM H	WIDTH OF SECTION	P H. WATER PRES.	X POINT APPLIED	OVERTURNING MOM.	ΣM/W	DISTANCE FROM FACE	INSIDE MID THIRD
ELEV 503 - ELEV 503.5	0.38	1.89	5.00	0.26 T.	0.78'	0.19	0.50	2.39	0.88
" 502.0	1.03	2.56	6.86	0.58	1.38	0.80	0.77	3.39	0.88
" 499.17	5.98	4.39	11.80	3.18	2.27	13.58	2.27	6.66	1.21
" 497.33	13.93	5.87	16.80	7.98	4.92	51.49	3.[illegible]	9.92	1.02
" 490.0	28.63	7.50	28.00	13.88	9.42	127.80	5.38	12.88	1.79

WATER UPLIFT

WITHIN MASONRY FROM FULL HEAD AT HEEL TO ZERO AT TOE ACTING ON ⅔ OF AREA
AT FOUNDATION (EL 490) FULL HEAD AND TAILWATER ACTING ON ⅔ AREA

BLOCK	W WT. TONS	DIST. FROM H
ELEV 503 - ELEV 503.5	0.16 T	1.67
" 502.0	0.27	2.28
" 499.17	0.92	3.93
" 497.33	1.90	4.90
" 490.0	6.62	9.10

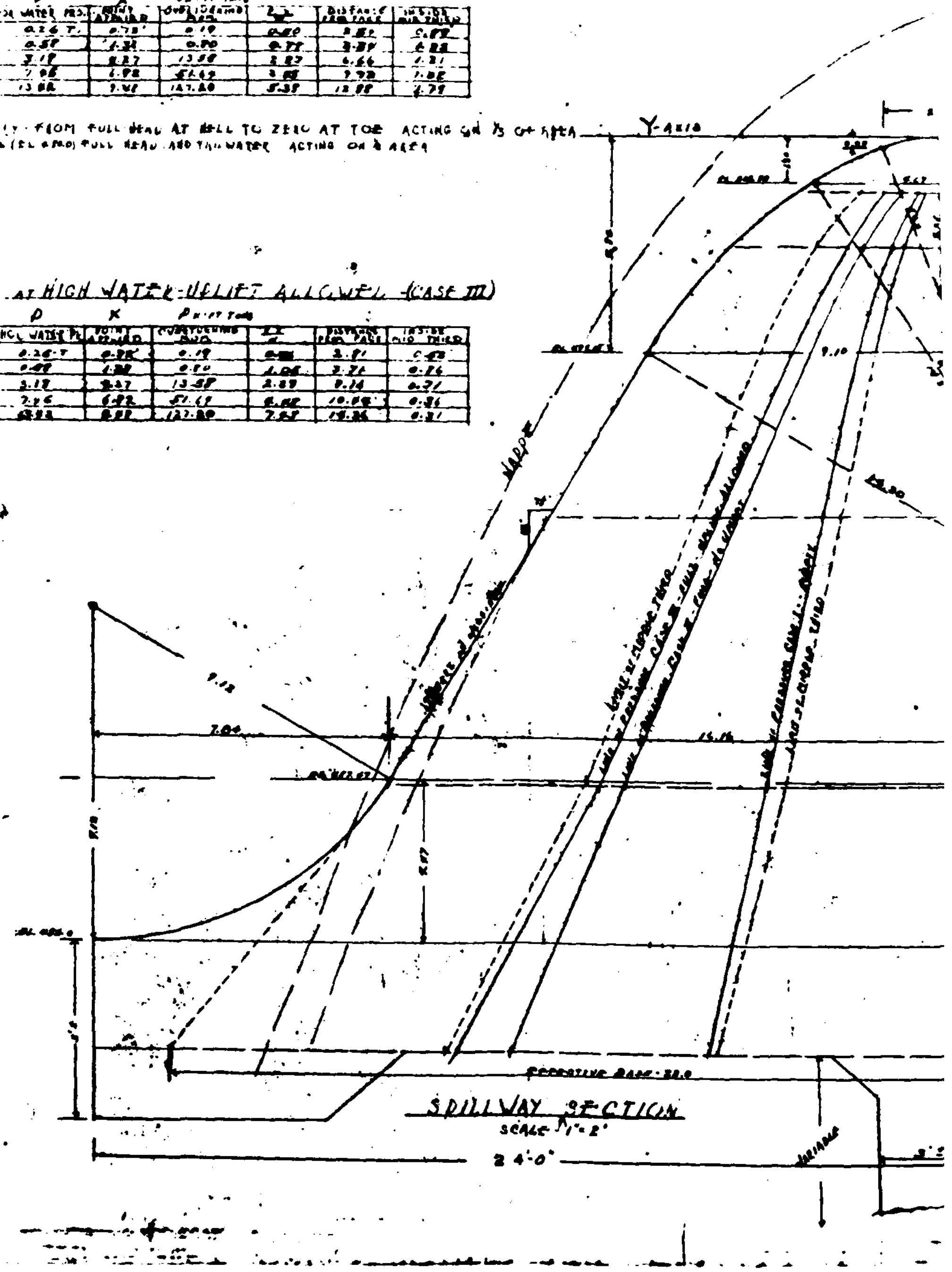
RESERVOIR AT HIGH WATER - UPLIFT ALLOWED (CASE III)

BLOCK	W WT. TONS	DIST. FROM H	WIDTH OF SECTION	P H. WATER P.	X POINT APPLIED	OVERTURNING MOM.	ΣM/W	DISTANCE FROM FACE	INSIDE MID THIRD
ELEV 503 - ELEV 503.5	0.22	1.95	5.00	0.26 T	0.78'	0.19	[illegible]	2.91	0.43
" 502.0	0.76	2.66	6.86	0.58	1.38	0.80	1.06	3.72	0.76
" 499.17	5.06	4.58	11.80	3.18	2.27	13.58	2.89	7.14	0.71
" 497.33	11.53	5.96	16.80	7.96	4.92	51.49	4.82	10.58	0.81
" 490.0	[illegible]	6.[illegible]	28.00	13.88	9.88	127.80	7.95	15.36	0.31

MASONRY AND NAPPE PROFILE

Y	VALUES OF X: MASONRY LINE	UPPER SURFACE NAPPE	LOWER SURFACE NAPPE
0.00	0.59	-3.86	0.59
0.27	0.17	-3.70	0.17
0.98	0.03	-3.60	0.03
1.[illegible]	0.00	-3.43	0.00
1.27	0.08	-3.21	0.03
2.[illegible]	0.21	-2.90	0.21
[illegible]	0.66	-2.39	0.72
3.67	1.20	-1.79	1.25
4.00	1.86	-1.02	1.90
4.59	2.70	-0.15	2.76
[illegible]	4.15	+1.93	4.30
[illegible]	8.05	+2.11	5.93
11.27	10.10	+7.00	9.00
14.00	10.10	11.70	12.52
16.66	17.53	16.60	19.97
18.70	20.00	23.38	26.20
21.00	21.58	36.10	33.00

NOTE: AS PER CREAGER AND JUSTINS
HYDROELECTRIC HANDBOOK - PAGE 209
UNITY CREST PROFILE.
MODIFIED SLIGHTLY TO SECURE
REGULAR CURVE AND SLOPES



SPILLWAY SECTION

SCALE 1" = 2'

24'-0"

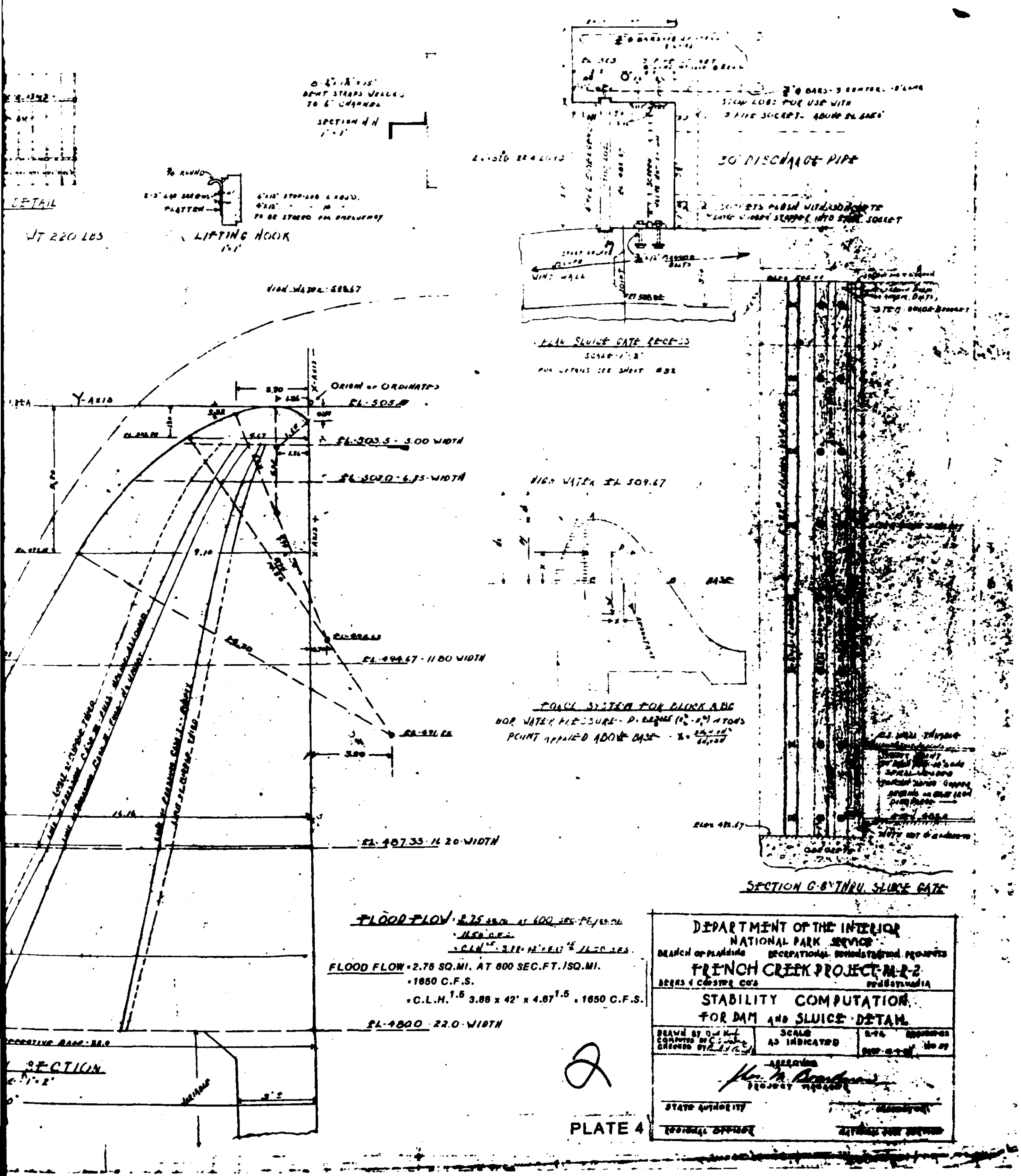

LIFTING HOOK
WT 220 LBS
SECTION H-H
30" DISCHARGE PIPE
PLAN SLUICE GATE RECESS
ORIGIN OF ORDINATES
Y-AXIS
X-AXIS
EL 505
EL 503.5 - 5.00 WIDTH
EL 502.0 - 6.75 WIDTH
EL 494.67 - 11.80 WIDTH
EL 487.35 - 16.20 WIDTH
EL 480.0 - 22.0 WIDTH
HIGH WATER EL 509.67
BASE
FORCE SYSTEM FOR BLOCK ABC
SECTION G-G THRU SLUICE GATE
FLOOD FLOW = 2.75 SQ.MI. AT 600 SEC.FT./SQ.MI.
= 1650 C.F.S.
= C.L.H.1.5 3.88 x 42' x 4.67 1.5 = 1650 C.F.S.
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
FRENCH CREEK PROJECT
STABILITY COMPUTATION
FOR DAM AND SLUICE DETAIL
AS INDICATED
PROJECT MANAGER
STATE AUTHORITY
REGIONAL OFFICER
2

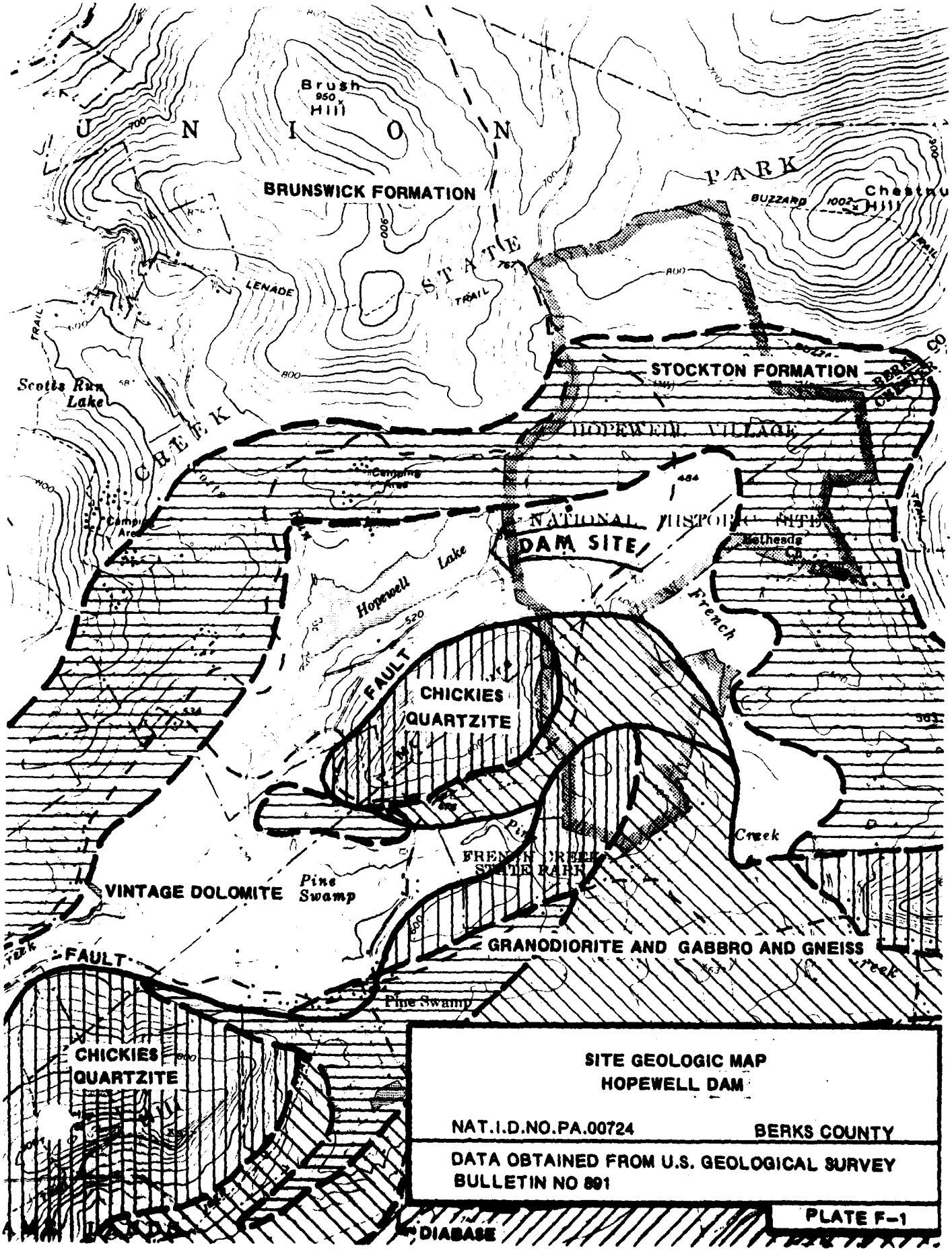
PLATE 4

APPENDIX

F

SITE GEOLOGY
HOPEWELL DAM

Hopewell Dam is located in the Triassic Lowland Section of the Piedmont Physiographic Province. As shown on Plate F-1, the bedrock at the site is the Vintage Dolomite of lower Cambrian age. No bedrock exposures were observed during the field inspection and, therefore, the bedrock type and its extent are drawn from the geologic mapping published by the U.S. Geological Survey in 1938. As shown on Plate F-1, the left abutment and spillway areas are in the vicinity of the contact between the Vintage Dolomite and the Triassic age shale and sandstone beds of the Stockton Formation. Contained in the Department of Environmental Resources files in Harrisburg is limited information describing the bedrock. Progress reports describe bedrock in the left abutment and spillway areas as badly broken shale and sandstone dipping to the left (northerly). Therefore, it may be correct to assume that the left portion of the dam is underlain by the Stockton Formation and the right portion of the dam is underlain by the solution prone Vintage Dolomite. A regional thrust fault, referred to as the Elverson Overthrust, and related faults strike northeasterly through the hillsides within 1,000 feet south of the dam.

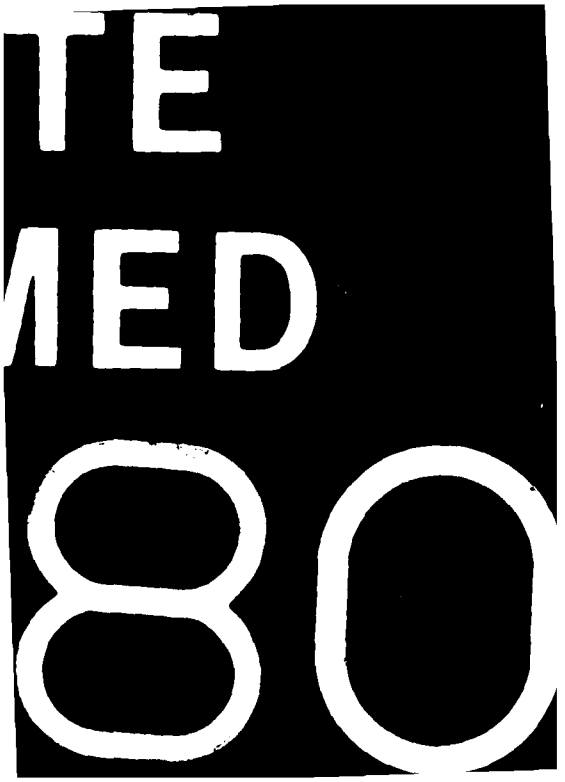


SITE GEOLOGIC MAP
HOPEWELL DAM

NAT.I.D.NO.PA.00724 BERKS COUNTY

DATA OBTAINED FROM U.S. GEOLOGICAL SURVEY
BULLETIN NO 891

PLATE F-1


TE
MED
80